ASTM BULLETIN

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1955 ASTM Committee Week in Cincinnati, January 31 to February 4

Symposium Relating to Metals at Elevated Temperatures Features Annual Gathering of Many Technical Committees

Once again Cincinnati will be the location for an ASTM Committee Week with the beautiful Netherland Plaza Hotel as headquarters. 1955 ASTM Committee Week will be January 31 to February 4.

Taking advantage of the opportunity presented by Committee Week to concentrate their meetings in a given time and place with the resultant saving in travel time and expense, committee members have scheduled scores of meetings of technical committees and their subdivisions for this week. In addition, the Joint Committee on Effect of Temperature on the Properties of Metals has arranged a Symposium on Basic Effects of Environment on Strength, Scaling, and Embrittlement of Metals at Elevated Temperatures, for Wednesday, February 2, morning and afternoon.

Room Reservations

Sufficient sleeping rooms to house those attending 1955 Committee Week have been set aside at the Netherland Plaza and Terrace Plaza Hotels. Arrangements have also been made with the Sheraton-Gibson and Sinton Hotels for additional rooms. Hotel reservation forms will go into the mails shortly to all members and committee members. Those who expect to participate in Committee Week activities are urged to return these forms as promptly as possible in order to obtain the accommodations they desire. To assist our members in determining what days they should attend, the letter of transmittal will contain a tentative schedule of committee meetings by days.

Committee Meetings

All members of technical committees will be advised by their officers of the details of time and location of their meetings in Cincinnati. Final arrangements for attending the meeting should be based on this official notice from committee officers. As this issue of the Bulletin goes to press, the following committees have indicated their intention to meet during Committee Week:

A-3 on Cast Iron
A-5 on Corrosion of Iron and Steel
A-7 on Malleable-Iron Castings
A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys
B-3 on Corrosion of Non-Ferrous Metals and Alloys
B-6 on Die-Cast Metals and Alloys
B-7 on Light Metals and Alloys, Cast and Wrought
B-8 on Electrodeposited Metallic Coatings
C-1 on Cement
C-7 on Lime
C-8 on Refractories
C-9 on Concrete and Concrete Aggregates
C-11 on Gypsum
C-12 on Mortars for Unit Masonry
C-15 on Manufactured Masonry Units
C-17 on Asbestos-Cement Products
D-4 on Road and Paving Materials
D-5 on Coal and Coke

Netherland Plaza (left) and Terrace Plaza Hotels.

D-8 on Bituminous Waterproofing and Roofing Materials
D-11 on Rubber and Rubber-Like Materials
D-16 on Industrial Aromatic Hydrocarbons and Related Materials
D-19 on Industrial Water
E-1 Subcommittees
E-4 on Metallography
E-7 on Non-Destructive Testing
E-9 on Fatigue
E-10 on Radioactive Isotopes

Papers on Radioactive Isotopes

The main meeting of Committee E-10 on Radioactive Isotopes will include a session at which the following three papers will be presented:

Measuring Traffic Paint Abrasion with Beta Rays—B. W. Pocock, Michigan State Highway Dept.

High Resolution Autoradiography—Henry J. Gomberg, University of Michigan

Effects of Radiation on Materials—V. P. Calkins, General Electric Co.

All those interested are invited to attend.

Symposium on Metals at Elevated Temperature

The Symposium on Basic Effects of Environment on Strength, Scaling, and Embrittlement of Metals at Elevated Temperatures will be held at two sessions, morning and afternoon, on Wednesday, February 2.

Under the chairmanship of E. A. Davis, Westinghouse Electric Corp., seven papers have been prepared by experts in this field covering various phases of the problem. These papers with abstracts, are listed below.

Ohio Valley District Dinner

Concurrently with Committee Week the Ohio Valley District and the Cincinnati Chapter of The American Society for Metals will hold a joint meeting which will be addressed by ASTM President Norman L. Mochel. Scheduled for Wednesday evening, February 2, this meeting will be preceded by a dinner. All who are in Cincinnati during this week are cordially invited to attend the dinner and to participate in the technical program.

Symposium on Basic Effects of Environment on Strength, Scaling, and Embrittlement of Metals at Elevated Temperatures

Physical Chemical Behavior of Metals and Alloys at High Temperatures in Oxidizing Atmospheres—Earl A. Gulbransen, Westinghouse Electric Corp.

The various reactions that occur in a metal-oxide system in oxidizing atmospheres are summarized and briefly discussed from thermodynamic and kinetic points of view.

The over-all performance of metals and alloys in oxidation is a function of a number of factors in addition to the normal oxidation resistance. In particular, the resistance to stress is of critical importance. Experimental studies are presented to show the effect of alloying elements on stress-oxidation as well as the influence of solid phase reactions for a number of metals and alloys.

The Properties of Oxidation-Resistant Scales Formed on Molybdenum-Base Alloys at Elevated Temperatures—Molly Gleiser, W. L. Larsen, J. W. Spretnak, and R. Speiser, Ohio State University

Due to the limitations of externally applied claddings for protecting molybdenum-base alloys from oxidation at elevated temperatures, a program of developing protective self-regenerative scales on molybdenum-base alloys was conducted.

Nickel and cobalt molybdates appeared promising. Results of oxidation tests show that molybdate scales will form on molybdenum-nickel and molybdenum-cobalt alloys and are protective.

Both nickel and cobalt molybdates spall upon thermal cycling. Spalling can be suppressed by the addition of certain third components which stabilize the molybdate crystal structure.

Structure of Oxides Formed on High Temperature Alloys at 1500 F—John F. Radavich, Purdue University

The high-temperature resistance of iron-nickel-chromium alloys is determined for the most part by the structural, chemical, and physical nature of the oxides formed on the surface. The physical properties of the metal are influenced, among other things, by the phases precipitated in the metal, the number of cracks formed in the metal, type of oxides formed, and the healing influence of the oxide films on crack formation

Small additions of cobalt, molybdenum, and tungsten to iron-nickel-chromium alloys produce alloys with superior high-temperature properties. Work was undertaken to study the oxide structures formed on various high-temperature alloys by means of electron microscopy, electron diffraction, and X-ray diffraction.

Oxidation at Elevated Temperatures—John F. Radavich, Purdue University

This paper is the result of a study of the behavior of the base metal beneath the oxide films. The objective is to show the course of oxidation in the matrix and in the grain boundaries. This investigation is closely related to that described in the preceding paper.

The Influence of Thin Surface Films on The Mechanical Properties of Metal Crystals—John G. Gilman, General Electric Co.

The paper will consist of a critical review of the literature on the effects of thin surface films on slip, creep, twinning, fracture, etc., of metal crystals.

Effect of Environment on the Tensile Creep Properties of Several Metals and Alloys—R. B. Oliver, W. D. Manly, D. A. Douglas, and J. H. DeVan, Carbide and Carbon Chemicals Co.

In the past, the creep properties of metals have nearly always been measured in air. For the unique applications in nuclear reactor design, service environments other than air were anticipated. A testing program was instituted at the Oak Ridge National Laboratory, to evaluate the effects of air, argon, hydrogen, nitrogen, liquid metals, and fused salts on the tensile creep-rupture strength of iron- and nickel-base alloys.

An Investigation of Intergranular Oxidation in Some Stainless Steels—R. E. Keith, C. A. Siebert, and M. J. Sinnott, University of Michigan

Stainless steels are known to be subject to preferential attack at grain boundaries under oxidizing conditions. The purpose of this investigation was to study the effects of time, temperature, and minor changes in alloy composition upon the severity of intergranular oxidation brought about by exposure at temperature to dry air under flow conditions and to determine whether the compositions of intergranular oxides differed appreciably from surface oxides.

Specimens of eight heats of type 310 and one heat of type 309 stainless steels were oxidized four times between 10 and 100 hr at temperatures between 1600 and 2000 F. A metallographic method was devised to measure quantitatively the severity of intergranular oxidation in tested specimens. X-ray powder patterns were made of external scales from selected specimens. Intergranular oxides were analyzed by means of a technique of successive etches coupled with reflection electron diffraction measurements.

Fall Actions of ASTM Administrative Committee on Standards

In recent actions taken by the ASTM Administrative Committee on Standards approval was given to recommendations from 16 of the Society's technical committees. These actions are listed in the accompanying box and are briefly described below.

Steel

Committee A-1 proposed one new specification and revisions of a number of tentative specifications.

In response to a request from ASA Sectional Committee B 31, Tentative Specifications for Metal-Arc Welded Steel Pipe for High-Pressure Transmission Service (A 381) were developed to fill a definite need. They cover straight seam double submerged arc-welded steel pipe 16 in. and larger in outside diameter, with wall thicknesses from $\frac{5}{16}$ to $1\frac{1}{2}$ in. inclusive. The pipe is intended for carrying liquid, gas, or vapor, and is suitable for bending, flanging (vanstoning), corrugating, and similar operations. The Sectional Committee hopes to refer to these specifications in the next revision of the Code for Pressure Piping.

Tentative Specifications for Billet-Steel Bars for Concrete Reinforcement (A 15) were revised with respect to the cold bend test requirements for deformed bars to reflect more clearly uniform testing procedures.

Test requirements of the following Tentative Specifications were revised and unified with those outlined in the Tentative Methods and Definitions for the Mechanical Testing of Steel Products (A 370):

- General Requirements for Delivery of Rolled Steel Plates (A 20)
- Boiler and Firebox Steel for Locomotives (A 30)
- Open-Hearth Iron Plates of Flange Quality (A 129)
- Carbon-Silicon Steel Plates of Intermediate Tensile Ranges for Fusion-Welded Boilers and Other Pressure Vessels (A 201)
- Chromium-Manganese-Silicon (CMS) Alloy-Steel Plates for Boilers and Other Pressure Vessels (A 202)
- Nickel-Steel Plates for Boilers and Other Pressure Vessels (A 203)
- Molybdenum-Steel Plates for Boilers and Other Pressure Vessels (A 204)
- High Tensile Strength Carbon-Silicon Steel Plates for Boilers and Other Pressure Vessels (A 212)
- Manganese-Vanadium Steel Plates for Boilers and Other Pressure Vessels (A 225)
- Low and Intermediate Tensile Strength Carbon-Steel Plates of Flange and Firebox Qualities (plates 2 in. and under in thickness) (A 285)
- High Tensile Strength Carbon-Manganese-Silicon Steel Plates for Boilers and Other Pressure Vessels (A 299)
- Steel Plates for Pressure Vessels for Service at Low Temperatures (A 300)
- Chromium-Molybdenum Steel Plates for Boilers and Other Pressure Vessels (A 301)
- Manganese-Molybdenum Steel Plates for Boilers and Other Pressure Vessels (A 302)
- Low-Carbon High-Nickel Steel Plate for Pressure Vessels (A 353)
- 5 per cent Chromium, 0.5 per cent Molybdenum Steel Plates for Boilers and Other Pressure Vessels (A 357)

Easing of the scrap shortage has made it possible for Committee A-1 to recommend withdrawal of emergency alternate provisions relating to phosphorus content in the following specifications:

- Seamless Cold-Drawn Intermediate Alloy-Steel Heat-Exchanger and Condenser Tubes (A 199)
- Seamless Intermediate Alloy-Steel Still Tubes for Refinery Service (A 200)
- Seamless Alloy-Steel Boiler, Superheater, and Heat Exchanger Tubes (A 213)
- Welded Austenitic Stainless Steel Boiler, Superheater, Heat Exchanger and Condenser Tubes (A 249)
- Seamless and Welded Ferritic Stainless Steel Tubing for General Service (A 268)
- Seamless and Welded Austenitic Stainless Steel Tubing for General Service (A 269)
- Seamless and Welded Austenitic Stainless Steel Sanitary Tubing (A 270)
- Seamless Austenitic Chromium-Nickel Steel Still Tubes for Refinery Service (A 271)
- Seamless and Welded Austenitic Stainless Steel Pipe (A 312)

Light Metals and Alloys

One new recommended practice and revisions of eight existing tentative specifications were proposed by Committee B-7. The Recommended Practice for Temper Designation of Light Metals and Alloys, Cast and Wrought (B 296) is an explanation of the system for designating tempers which are used in the specifications under the jurisdiction of Committee B 7. The designations are based on the sequence of basic treatments used to produce the temper, and for all metal forms except ingot follow the alloy designation separated by a dash. Basic designations consist of letters; subdivisions where required are indicated by digits following the letter.

In the revision of Tentative Specifications for Magnesium-Base Alloy Sand Castings (B 80) and for Magnesium-Base Alloy Permanent Mold Castings (B 199) a new Table IV is added entitled "Properties and Characteristics" to give information on melting ranges, pattern shrinkage allowance, foundry characteristics, and other characteristics.

To Tentative Specifications for Aluminum and Aluminum-Alloy Sheet and Plate for Pressure Vessel Applications (B 178) and Tentative Specifications for Aluminum-Alloy Sheet and Plate (B 209) is added a new alloy designated GM40A (commercially known as AA5086).

Table II in Tentative Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, and Shapes (B 221) is revised to change the minimum tensile strength for GS10A-T6 from 32,000 to 30,000 psi. The committee found that production experience had shown the former value to be too high.

To Tentative Specifications for Aluminum Alloy Drawn Seamless Tubes for Condensers and Heat Exchangers (B 234) are added the alloys GS11A (commercial designation AA6061) and GS11C (commercial designation AA6062).

Revision of Tentative Specifications for Aluminum-Base Alloy Permanent Mold Castings (B 108) consists of adding a new temper for Alloy ZG42A, a change that reflects current commercial practice.

The Tentative Specifications for Aluminum-Base Alloy Sand Castings (B26) were revised by the addition of a new temper for alloy ZG42A, and a change in the yield strength of alloy ZG61A.

Filler Metal

The Joint AWS-ASTM Committee on Filler Metal submitted for approval Tentative Specifications for Nickel and Nickel-Base Alloy Covered Welding Electrodes (B 295). These specifications cover nickel and nickel-base alloy electrodes for shielded metal-arc welding nickel and nickel-base alloys individually to themselves and also for welding these materials to steel and for welding the clad side of nickel-base alloy clad steels.

Latest Actions Taken by Administrative Committee on Standards

New Tentatives

Methods of:

- Test for Flexural Strength of Hydraulic-Cement Mortars (C 348 – 54 T)[a]
- Test for Compressive Strength of Hydraulic-Cement Mortars Using Portions of Prisms Broken in Flexure (C 349 – 54 T)[a]
- Test for Mean Specific Heat of Thermal Insulation (C 351 – 54 T)[b]
- Determination of Total Sulfur in Fuel Gases (D 1072 – 54 T)[a]
- Test for Silicone Insulating Varnishes (D 1346 – 54 T)[a]
- Test for the Evaluation of the Acute Toxicity of Industrial Waste Water to Fresh Water Fishes (D 1345 – 54 T)[a]
- Testing Methylcellulose (D 1347)[d]
- Moisture in Cellulose (D 1348 – 54 T)[d]
- Photometric Methods for Determination of Manganese in Steel (E 30 – 54 T)[b]
- Chemical Analysis of Ferro-Alloys (E 31 – 54 T)[b]
- Chemical Analysis of Copper-Beryllium Alloys (E 106 – 54 T)[b]
- Photometric Methods for Chemical Analysis of Electronic Nickel (E 107 – 54 T)[b]

Specifications for:

- Metal-Arc Welded Steel Pipe for High-Pressure Transmission Service (A 381 – 54 T)[a]
- Nickel and Nickel-Base Alloy Covered Welding Electrodes (B 295 – 54 T)[b]
- Lightweight Aggregates for Insulating Concrete (C 32 – 54 T)[c]
- Fly Ash for use as an Admixture for Portland-Cement Concrete (C 350 – 54 T)

Recommended Practice for:

- Temper Designation of Light Metals and Alloys, Cast and Wrought (B 296 – 54 T)[a]
- Probability Sampling of Materials (E 105 – 54 T)[a]

Revision of Standards and Reversion to Tentative

Methods of:

- Test for Compressive Strength of Hydraulic Cement Mortars (C 109 – 54 T)[a]

Specifications for:

- Ready-Mixed Concrete (C 94 – 54 T)[a]
- Soluble Nitrocellulose (D 301 – 54 T)[d]
- Natural Block Mica and Mica Films Suitable for Use in Fixed Mica Dielectric Capacitors (D 748 – 54 T)[a]
- Measurement of Gaseous Fuel Samples (D 1071 – 54 T)[a]
- Photometric Methods for Chemical Analysis of Lead, Tin, Antimony, and Their Alloys (E 87 – 54 T)[b]

Methods of:

- Testing Electrical Insulating Oils (D 117 – 54 T)[a]
- Test for Fly Ash as an Admixture for Portland Cement-Concrete (C 311 – 54 T)[a]
- Tensile Properties of Thin Plastic Sheets and Films (D 882 – 54 T)[a]
- Test for Unsaponifiable Matter in Rosin (D 1065 – 54 T)[c]

Revision of Tentatives

Specifications for:

- Billet-Steel Bars for Concrete Reinforcement (A 15 – 54 T)[b]
- General Requirements for Delivery of Rolled Steel Plates of Flange and Firebox Qualities (A 20 – 54 T)[b]
- Boiler and Firebox Steel for Locomotives (A 30 – 54a T)[b]
- Open-Hearth Iron Plates of Flange Quality (A 129 – 54 T)[b]
- Carbon-Silicon Steel Plates of Intermediate Tensile Ranges for Fusion-Welded Boilers and Other Pressure Vessels (A 201 – 54 T)[b]
- Chromium-Manganese-Silicon (CMS) Alloy-Steel Plates for Boilers and Other Pressure Vessels (A 202 – 54 T)[b]
- Nickel-Steel Plates for Boilers and Other Pressure Vessels (A 203 – 54 T)[b]
- Molybdenum-Steel Plates for Boilers and Other Pressure Vessels (A 204 – 54 T)[b]
- High Tensile Strength Carbon-Silicon Plates for Boilers and Other Pressure Vessels (A 212 – 54 T)[b]
- Manganese-Vanadium Steel Plates for Boilers and Other Pressure Vessels (A 225 – 54 T)[b]
- Low and Intermediate Tensile Strength Carbon-Steel Plates of Flange and Firebox Qualities (Plates 2 in. and Under in Thickness) (A 285 – 54 T)[b]
- High Tensile Strength Carbon-Manganese-Silicon Steel Plates for Boilers and Other Pressure Vessels (A 299 – 54 T)[b]
- Steel Plates for Pressure Vessels for Service at Low Temperatures (A 300 – 54 T)[b]
- Manganese-Molybdenum Steel Plates for Boilers and Other Pressure Vessels (A 302 – 54 T)[b]
- Low-Carbon High-Nickel Steel Plate for Pressure Vessels (A 353 – 54 T)[b]
- 5 per cent Chromium, 0.5 per cent Molybdenum Steel Plates for Boilers and Other Pressure Vessels (A 357 – 54 T)[b]
- Aluminum-Base Alloy Sand Castings (B 26 – 54 T)
- Magnesium-Base Alloy Sand Castings (B 80 – 54 T)[a]
- Aluminum-Base Alloy Permanent Mold Castings (B 108)[c]
- Aluminum and Aluminum-Alloy Sheet and Plate for Pressure Vessel Applications (B 178 – 54 T)[a]
- Aluminum and Aluminum-Alloy Sheet and Plate (B 209 – 54 T)[a]
- Magnesium-Base Alloy Permanent Mold Castings (B 199 – 54 T)[a]
- Aluminum and Aluminum-Alloy Extruded Bars, Rods, and Shapes (B 221 – 54 T)[a]
- Aluminum-Alloy Drawn Seamless Tubes for Condensers and Heat Exchangers (B 234 – 54 T)[a]
- Concrete Aggregates (C 33 – 54 T)[a]
- Drain Tile (C 4 – 54 T)[a]
- Gasoline (D 439 – 54 T)[b]

Withdrawal of Tentatives

Methods of:

- Test for Time of Setting of Hydraulic Cement in Mortar (C 229 – 54 T)[a]

Withdrawal of Emergency Alternates Relating to Phosphorus

Specifications for:

- Seamless Cold-Drawn Intermediate Alloy-Steel Heat-Exchanger and Condenser Tubes (A 199 – 54 T)[b]
- Seamless Intermediate Alloy-Steel Still Tubes for Refinery Service (A 200 – 54 T)[b]
- Seamless Alloy Steel Boiler, Superheater, and Heat Exchanger Tubes (A 213 – 54 T)[b]
- Welded Austenitic Stainless Steel Boiler, Superheater, Heat Exchanger and Condenser Tubes (A 249 – 54 T)[b]
- Seamless and Welded Ferritic Stainless Steel Tubing for General Service (A 268 – 54)[b]
- Seamless and Welded Austenitic Stainless Steel Tubing for General Service (A 269 – 54)[b]
- Seamless and Welded Austenitic Stainless Steel Sanitary Tubing (A 270 – 54)[b]
- Seamless Austenitic Chromium-Nickel Steel Still Tubes for Refinery Service (A 271 – 54)[b]
- Seamless and Welded Austenitic Stainless Steel Pipe (A 312 – 54 T)[b]

[a] Approved September 28.
[b] Approved October 4.
[c] Approved November 5.
[d] Approved November 10.

Cement

Two new test methods were proposed by Committee C-1 as Tentative Methods of Test for Flexural Strength of Hydraulic-Cement Mortars (C 348) and Tentative Methods of Test for Compressive Strength of Hydraulic-Cement Mortars Using Portions of Prisms Broken in Flexure (C 349).

The purpose of developing these methods was to provide procedures for making certain strength tests in which considerable interest has been evidenced. These methods were the subject of a recent extended cooperative study sponsored by the Subcommittee on Strength, in which nine laboratories participated. These methods were published in full, in their earlier draft, in the December, 1953, issue of the ASTM BULLETIN, pages 31–35.

As explained in detail in the February, 1954, issue of the ASTM BULLETIN, the committee recommended revision and reversion to tentative status of the Method of Test for Compressive Strength of Hydraulic Cement Mortars (C 109). In this revision mechanical mixing is substituted for the manual mixing formerly employed in preparing the standard test mortars and certain desired refinements are made in various details of the test procedure.

Because the Tentative Method of Test for Time of Setting of Hydraulic Cement in Mortar (C 229) appeared in view of lack of use to be not needed, the committee recommended that it be withdrawn.

Concrete and Concrete Aggregates

Committee C-9 recommended approval of Tentative Specifications for Lightweight Aggregates for Insulating Concrete (C 332) as the last of three tentatives which they have developed to replace Standard Specifications for Lightweight Aggregates for Concrete (C 130) which were withdrawn in June, 1954 (see page 6 of the Annual Report of Committee C-9). The other two methods were approved by the Administrative Committee on Standards on December 16, 1954.

Two interrelated actions by Committee C-9 cover fly ash. Their proposed Tentative Specifications for Fly Ash for Use as an Admixture for Portland-Cement Concrete (C 350) cover the use of additions of suitable fine material where such additions would seem to promote workability and plasticity. Use of fly ash as a direct substitute for portland cement is not within the scope of these specifications.

The above specifications having been accepted as tentative, the committee was able to submit revisions of Tentative Methods of Test for Fly Ash as an Admixture for Portland-Cement Concrete (C 311). These methods had originally been written around a draft of a specification that was not adopted, and are now revised to accord with the new specification.

The revisions of Tentative Specifications for Concrete Aggregates (C 33) brings them in line with present practice.

The committee also recommended revision of Standard Specifications for Ready-Mixed Concrete (C 94) and reversion to tentative status. This action was prompted by analysis of recent studies of equipment performance and similar work.

Manufactured Masonry Units

The Tentative Specifications for Drain Tile (C 4) have been unchanged for four years and Committee C-15 has made a thorough revision of the specifications based on experience in their use in the last four years.

Thermal Insulating Materials

A new method that has been in demand by industry for some time was developed by Committee C-16 as Tentative Method of Test for Mean Specific Heat of Thermal Insulation (C 351). Because of the great amount of research necessary it has taken several years to reach completion. Materials tested by this method must be essentially homogeneous and composed of matter in the solid state. The classical method of mixtures is employed in this method which provides procedures and apparatus simpler than those generally used in scientific calorimetry, an accuracy that is adequate for most thermal insulating purposes, and a degree of precision that is reproducible by laboratory technicians of average skill.

It is one of several methods under preparation by the committee for the measurement of special thermal properties.

Petroleum Products and Lubricants

The minimum octane number requirements for regular and premium-price gasolines which are given in Table I of Tentative Specification for Gasoline (D 439) are reviewed regularly by Technical Committee A of Committee D-2 and compared with the octane number levels of these gasolines reported in the National Motor Gasoline Survey. The 1953–1954 Winter Survey revealed a change in octane number level from 78 to 79 for regular gasoline and from 86 to 87 for premium gasoline. Specification D 439 was accordingly revised to reflect these changes.

Gaseous Fuels

Committee D-3, recognizing the importance of suitable methods for determination of special constituents in gaseous fuels, organized a subcommittee to develop such methods. The subcommittee decided that first attention should be given to methods for determination of sulfur and prepared Tentative Methods for Determination of Total Sulfur in Fuel Gases (D 1072). The method is intended for determination of sulfur when present in concentrations between 1.0 and 30 grains of sulfur per 100 cu ft and is applicable to natural gases, manufactured gases, and mixed gases such as are distributed by gas utility companies.

Approval was also given to the committee's recommendation of revisions of the Tentative Methods for Measurement of Gaseous Fuel Samples (D 1071). Since their original publication, a number of suggestions were offered for modification of the provisions dealing with meter calibration in order to clarify them further. After considerable study and experiment along these lines the present revisions were developed.

Electrical Insulating Materials

The new Tentative Methods of Test for Silicone Insulating Varnishes (D 1346) represent a great deal of work over a considerable period of time by Committee D-9. These methods cover tests for flexible silicone impregnating and coating varnishes primarily intended to provide electrical, mechanical, and chemical protection for electrical equipment.

Approval was also given to the committee's recommendation that the Standard Specifications for Natural Block Mica and Mica Films Suitable for Use in Fixed Mica-Dielectric Capacitors (D 748) be reverted to tentative status with revisions. The revisions proposed were for the most part editorial in nature and intended primarily to bring these specifications up to date and consistent with the Specifications for Natural Muscovite Mica (D 351). Certain other technical improvements are also included.

Addition of a section on "Scope" which indicates the broad application of these methods constitutes the revision of the Tentative Methods of Testing Electrical Insulating Oils (D 117). The scope reads as follows:

> "These methods of testing electrical insulating oils apply to mineral oils of petroleum origin for use in cables of certain types, transformers, oil circuit breakers and other electrical apparatus as an insulating or cooling medium or both. These methods are generally suitable for specification acceptance factory control, referee and research. Where a method is not generally applicable for all these types of application, its classification is indicated."

Naval Stores

Revision of Tentative Method of Test for Unsaponifiable Matter in Rosin (D 1065) recommended by Committee D-17 represents a consolidation of the present continuous extraction method and the proposed separatory funnel method (appended to the 1950 Annual Report of Committee D-17), modified to use the same saponification conditions now specified for unsaponifiable matter in Methods of Testing Tall Oil (D 803).

Industrial Water

A bio-assay procedure intended as a nonreferee batch method was recommended by Committee D-19 in Tentative Methods of Test for the Evaluation of the Acute Toxicity of Industrial Waste Water to Fresh Water Fishes (D 1345). This test provides information on the relative acute toxicity of the substance tested under prescribed experimental conditions. The committee felt that the biological method will yield significant information on the character of industrial wastes not obtainable by strictly analytical procedures.

Plastics

Committee D-20 revised Tentative Methods of Test for Tensile Properties of Thin Plastic Sheets and Films (D 882) in order to provide separate procedures appropriate to the three basically different types of tension testing machines in general use for tests of this kind. The results of these tests cannot be compared.

Cellulose and Cellulose Derivatives

Two new methods were proposed by Committee D-23. Method of Test for Moisture in Cellulose (D 1348) covers procedures for moisture determination by oven drying using a supply of predried air in the drying oven. They are applicable to a variety of cellulose types and can be used in most cases where a sample does not contain nonaqueous material volatile at 110 C. The methods can be used for samples having either high or low moisture content.

Tentative Methods of Testing Methylcellulose (D 1347) cover material quite similar to ethyl cellulose for which methods have been written in D 914. The new methods were written by the Dow Chemical Co. who, it is believed, is the only manufacturer at present.

Revision and reversion to tentative status of Specifications and Tests for Soluble Nitrocellulose (D 301) consist of: (1) changing the name of the product from nitrocellulose to cellulose nitrate, the more correct terminology; (2) consolidation of the description of the drying conditions into a separate section entitled "Drying Samples" and incorporation of precautionary statements on the hazards in handling dry cellulose nitrate; and (3) deletion of the present procedural details covering viscosity determination and reference of this determination to the new general viscosity method for cellulose derivative (D 1343).

Quality Control of Materials

The aims of the Tentative Recommended Practice for the Probability Sampling of Materials (E 105), developed by Committee E-11, are limited to (1) principles for guidance in the preparation of a sampling procedure for specific materials, and (2) principles for the guidance of other ASTM technical committees.

Chemical Analysis of Metals

Four new methods were proposed by Committee E-3. Tentative Photometric Methods for the Chemical Analysis of Electronic Nickel (E 107) and Tentative Methods of Chemical Analysis of Copper-Beryllium Alloys (E 106) are both new procedures for materials not previously covered, the latter providing analyses for the alloys covered by Specifications B 194, B 196, and B 197.

In Tentative Methods for Chemical Analysis of Ferro-Alloys (E 31), the committee developed a new procedure for silicon that is equivalent in accuracy and more rapid in performance than that now covered in Sections 58, 59, and 60 of E 31; they are intended eventually to replace those methods. These methods also include new procedures for determination of titanium, aluminum, silicon, and carbon in ferrotitanium which will be added to E 31.

Tentative Photometric Method for Determination of Manganese in Steel (E 30) is a more rapid and alternate method for the determination of manganese in low-alloy, stainless, and tungsten steels.

Tentative Photometric Methods for the Chemical Analysis of Lead, Tin, Antimony, and Their Alloys (E 87) were revised by a task group of the committee which felt it necessary to change the technical content of Sections 11 through 13.

National Institute of Governmental Purchasing Meets at New York

"MORE Value for the Tax Dollar" was again the theme of the program of the Ninth Annual Conference and Product Exhibit of the National Institute of Governmental Purchasing at the Hotel Statler, N. Y., October 10–13, 1954. Featured speakers at the two conference luncheons were Stuart F. Heinritz, Editor, *Purchasing Magazine*, and Roger E. Gay, President of the Bristol Brass Corp., the current president of ASA.

The conference program consisted of a series of seminars, clinics, and papers on a variety of subjects dealing with the problems and fundamentals of purchasing by public agencies. Among the topics presented were *Development and Use of Standard Specifications* by Herbert S. Schenker, Superintendent of Standards, Procurement Department, Philadelphia, Pa.; a seminar, *Survey of Market Conditions*, with A. L. McMillan as moderator, which included the following discussions: Metals and Metal Fabrications by Abraham Giniger, Machinery and Shop Equipment by Samuel Adler, The Salvage Sales Market by Louis Raphael, Textiles and Clothing by Thomas Hinchey, Drugs and Chemicals by Maurice Moore, and The Food Market by George Basso; and a seminar on *Sources of Supply* at which John F. Ward, City Purchasing Agent, Chicago, Ill., presided. In addition to the seminars, the program included a number of round-table discussions. Several papers on topics of interest to public purchasing agents rounded out the program.

The Annual Exhibit of the NIGP displayed a wide variety of products that Government purchasing agents must buy, ranging from drinking cups to heavy-duty trucks. ASTM Standards and literature were on display in a prominent booth at the entrance to the meeting room with a Staff member in attendance each day. The interest in ASTM was even greater than the year before when the Society had its first display.

The NIGP is a nonprofit educational and technical organization of Government buying agencies in the United States and Canada.

Its capable and enthusiastic secretary, Albert Hall, and Mrs. Hall were presented with a beautifully engraved silver platter in recognition of the ten years Mr. Hall has guided the affairs of the NIGP through its rapid growth.

The basic professional objective of NIGP is to raise the standard of basic buying through the interchange of technical and professional information and ideas.

NEW ASTM PUBLICATIONS

Symposium on Effect of Cyclic Heating and Stressing on Metals at Elevated Temperatures

It has been long realized that much, if not most, engineering use of metals at elevated temperature involves periodic changes in temperature or stress or both. However, the engineer has available for most metals only constant stress and temperature data for design purposes. This poses the question of how changes in stress or temperature modify the constant stress and temperature behavior of metals and thus the designs based on such behaviors.

It was decided by the Gas Turbine and General Research Panels of the Joint ASTM-ASME Committee on the Effect of Temperature on the Properties of Metals to hold at the 1954 ASTM Annual Meeting a Symposium on the Effect of Cyclic Heating and Stressing on Metals at Elevated Temperatures, intended to cover those situations involving relatively slow changes in stress or temperature or both. In practice many such changes are aperiodic, and much of the experimental work covering this Symposium uses periodic variations. It is felt that certain general considerations may, however, be deduced from the experimental results therein. The papers and discussions held at that time have been published as *STP No. 165*.

The information in this Symposium should be of use both to the engineer-designer, as an aid in designing for stress or temperature variation, and to the researcher, as a spur to greater efforts to obtain more exact data or design criteria.

Titles and authors of the eight papers included in this Symposium are as follows:

Introduction—*D. N. Frey, Ford Motor Co.*
What We Need to Know About Creep—*John E. Dorn and Lawrence A. Shepard, University of California*
The Problem of Thermal Stress Fatigue in Austenitic Steels at Elevated Temperatures—*L. F. Coffin, Jr., General Electric Co.*
The Effect of Temperature Cycling on the Rupture Strength of Some High-Temperature Alloys—*J. Miller, General Electric Co.*
Experiments on the Effects of Temperature and Load Changes on Creep-Rupture of Steels—*G. V. Smith and E. G. Houston, United States Steel Corp.*
Effects of Cyclic Overloads on the Creep Rates and Rupture Life of Inconel at 1700 and 1800 F—*R. H. Caughey and W. B. Hoyt, M. W. Kellogg Co.*
The Creep-Rupture Properties of Aircraft Sheet Alloys Subjected to Intermittent Load and Temperature—*G. J. Guarnieri, Cornell Aeronautical Lab., Inc.*
Constant and Cyclic-Stress Creep Tests of Several Sheet Materials—*Ward F. Simmons and Howard C. Cross, Battelle Memorial Institute*
The Effect of Composition on the Scaling of Fe-Cr-Ni Alloys Subjected to Cyclic Temperature Conditions—*H. E. Eiselstein and E. N. Skinner, International Nickel Co., Inc.*
Summary—*D. N. Frey, Ford Motor Co.*

Copies of this 190-page symposium, *STP No. 165*, can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. Price: $3; to members, $2.25.

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Fatigue of Aluminum—Third Gillett Memorial Lecture

"Fatigue of Aluminum," the third Gillett Memorial Lecture by Richard L. Templin, is a comprehensive survey of an increasingly critical problem. In the wake of a phenomenally expanding technology in a new era of atom power and supersonic flight, designers and engineers are calling more and more urgently for materials, particularly light metals, which can endure without failure the stresses, repeated loads, and temperatures demanded in new machines, structures, and components.

This lecture, sponsored by ASTM and Battelle Memorial Inst., commemorates Horace W. Gillett one of the country's foremost metallurgists and first Director of Battelle. Mr. Templin, the author, is Assistant Director of Research and Chief Engineer of Tests, Aluminum Company of America, and past president of ASTM.

In his lecture Mr. Templin presents a description of the phenomena of metals fatigue and a discussion of its mechanism. He points out that while investigation of fatigue properties of aluminum alloys has been going on continuously for 35 years the enormous accumulation of data is still not sufficient to solve all the problems that have arisen. Specifically, a better knowledge of combined stress, repeated shear stresses, various stress-raiser configurations, all at both room and elevated temperatures is needed.

Mr. Templin shows that although much progress has been made in the evaluation of fatigue properties of aluminum-alloys structural components, the relative merits of different geometric configurations and fabrication procedures, the problems are still legion.

The author concludes that fatigue strengths can be improved in many cases by use of information from comparisons of different designs of components, a conclusion he considers valid for other metals as well as aluminum.

One of the most valuable features of this timely publication is an exhaustive Bibliography of 497 references which the author has compiled and classified by years, starting in 1899.

Copies of this lecture can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. Price: $1.50; to members, $1.15.

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Symposium on Odor

Nomenclature, measurement, and control of odor all present unique problems which have been increasingly recognized as important subjects for study.

Because the perceptive mechanism of odor is perhaps the least understood of men's senses, nomenclature must have a subjective basis and may be a source of confusion in communication if it is not clarified.

Problems in measurement are complicated by the facts that many odorants are easily perceived in concentrations that are undetectable by direct physical or chemical methods; and the measurement of an odor cannot be related to a perceptual mechanism (as can vision or sound) and therefore must be objective, or organoleptic. In the applica-

tions field there have been a number of interesting approaches to problems of odor control or modification, some of which have reached active commercial practice.

ASTM work in this field is carried on by a Task Group of the Subcommittee on Analytical Methods of Committee D-22 on Atmospheric Sampling and Analysis, and it was this group that developed the symposium which was held at the Society's 1954 Annual Meeting in Chicago. The papers given in that session, together with the discussions they evoked are now available as *STP No. 164*. Titles and authors of the papers are as follows:

Introduction—*A. Turk*

Odor: A Proposal for Some Basic Definitions—*E. Sagarin*

Catalytic Method of Measuring Hydrocarbon Concentrations in Industrial Exhaust Fumes—*R. J. Ruff*

The Design, Construction, and Use of an Odor Test Room—*N. Deininger and R. W. McKinley*

Organoleptic Appraisal of Three-Component Mixtures—*A. H. Gee*

Odor Pollution from the Official's Viewpoint—*C. W. Gruber*

Odor Control Methods: A Critical Review—*A. Turk*

Totaling 87 pages, copies of this Symposium can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. Price: $2.25; to members, $1.70.

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Standards on Metallic Electrical Conductors

SINCE its organization in 1909, ASTM Committee B-1, which includes in its personnel leading technical authorities concerned both with the use and manufacture of electrical conductors, has endeavored to make available acceptable testing procedures and sampling methods and specifications covering the quality and other essential features of metallic conductors. Within the past few years there has been intensified activity because of the new materials and composites coming into the picture. The standards in this special compilation, represent the careful and considered technical opinions of leading men in the industry.

This 272-page compilation contains 50 standards and specifications relating to copper and copper alloy, steel, composite copper and steel, light metals, tests, and sampling procedures.

Copies can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. Price: $3.25; to members, $2.50.

Standards on Petroleum Products and Lubricants

THIS special compilation of ASTM specifications, tests, and definitions covering petroleum products and lubricants is one of the most widely distributed ASTM publications. This is indicative of the intensive interest in evaluating the properties and quality of a wide range of petroleum products, and it also indicates the value of this book.

Sponsored by ASTM Committee D-2, the book has been issued annually since 1927, each edition giving the material in its latest approved form. Committee D-2 is one of the oldest ASTM committees, membership including widespread representation of leading technical men and engineers representing the consumers and producers of materials covered. While the number of voting members of the Main Committee is only 150, there are an additional 850 members of the D-2 technical committees, research divisions, and subcommittees.

The 1954 edition gives in their latest approved form over 100 test methods, numerous specifications, and lists of definitions of terms relating to petroleum.

In addition, several appendices are included covering the following proposed tests which are published as information only: Filterability of Jet Fuel; Mercaptan Sulfur in Jet Fuels (Potentiometric Titration Method); Individual Hydrocarbons in a C_4 Fractions by Infrared Spectrophotometric Method; Emulsion Characteristics of Steam-Turbine Oils; and Dielectric Constant Dissipation Factor of Aviation Fuels.

Also included in the compilation are Recommendations on the Form of ASTM Methods of Test for Petroleum Products and Lubricants; List of Proposed Methods Prepared by Committee D-2 and Published as Information Prior to 1954; Regulations Governing the Committee and other information on Committee D-2; and the latest D-2 Annual Report.

The methods of test for knock rating of engine fuels are issued in a special volume and not included in this compilation; and several other standards for measuring and sampling petroleum appear in the ASTM Manual on Measurement and Sampling Petroleum and Its Products.

This compilation has 920 pages and is available in heavy paper or cloth cover, from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. Price: $6; to members, $4.50. For cloth binding add 65 cents to these prices.

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Ultraviolet Index Cards

AN IBM punched-card index to ultraviolet spectra is now being distributed by the Society. This index, like the indexes to infrared spectra and to X-ray diffraction data currently available from the Society, is based on the system developed by L. E. Kuentzel of Wyandotte Chemicals Corp.

The first group of 597 ultraviolet index cards, which is available for immediate shipment, covers the spectra published in the book on "Ultraviolet Spectra of Aromatic Compounds," by R. A. Friedel and Milton Orchin. A second group of 687 cards, which will be available for distribution about the end of November, will cover spectra abstracted from the literature. The complete deck of 1284 index cards, together with a copy of the booklet "Codes and Instructions for Wyandotte-ASTM Punched Cards Indexing Spectral Absorption Data," will be shipped prepaid for $17 per set. This price will apply whether the two groups are shipped together or the first group is ordered for immediate shipment, with the second group to follow when available.

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Standards on Textile Materials

THE 112 ASTM standards developed by Committee D-13 on Textile Materials cover many of the widely used products of this industry. They provide methods of tests, tolerances within which textiles must come in order that they shall constitute good delivery on contract, and specification requirements—standards of quality. Seven new tentative methods of test are included relating to glass yarn, elastic fabrics, raw wool, tuft bind of pile floor coverings, yarn distortion in woven fabrics, length of cotton fibers, and micronaire fineness of cotton fibers. Twenty-four methods of test and specifications in the previous compilation have been revised. Included in the eleven appendices is a new proposed method of test for predicting differential dyeing behavior of cotton.

Also included in the compilation are the Report of Committee D-13 on Textile Materials, a list of ASTM papers and special publications on textiles, and related valuable information such as photomicrographs of fibers, yarn number conversion table and humidity table.

This 714-page compilation can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. Price: $5.50; to members, $4.25.

Federal Government Commodity Standardization

By Willis S. MacLeod

Director, Standards Division, General Services Administration

High on the list of progressive steps in commodity standardization is the recently issued General Services Administration regulation on Federal Specifications and Standards. This regulation fills a long-time need for a Government-wide statement of policies and procedures for the development and use of specifications and standards covering items of common use in the Federal Government.

Eminently important, the GSA regulation recognizes that Federal specifications and standards must be dynamic and up to date. To some this would seem to imply merely that they should be kept current with the changing needs of the Government and thus adequate for procuring items used by Federal agencies. To GSA it means this and much more.

GSA believes that specifications and standards must reflect the best technical knowledge and experience of Government and industry, must be responsive to technological advances, must provide an efficient and economical medium for filling the procurement needs of Federal agencies, and must make it easier for manufacturers to fill Government orders from their normal commercial production. Specifically included in the GSA regulation are the policies and procedures to be followed by all Federal agencies in achieving specifications and standards to meet these high objectives.

Assigned Agency Method

The system established by the GSA regulation for developing Federal specifications and standards is known as the assigned agency method. It supersedes the Technical Committee system of the Federal Specifications Board which was abolished April 22, 1952.

The assigned agency method provides the facility whereby, under GSA's leadership, the wealth of experience and ability of technical personnel of Federal agencies and industry will be utilized in maximum degree.

The policies and procedures of the regulation were developed cooperatively with other Federal agencies. Notable in this regard is the close coordination of GSA's standardization program with the expanding standardization program of the Department of Defense.

Under the assigned agency method Federal agencies will be given responsibility for development of specifications and standards projects for which they have specialized knowledge. As agencies consent to accept assignments, a schedule of specifications and standards projects will be carefully coordinated to meet the most pressing needs of agencies.

Interim Federal Specifications will be developed by assigned agencies with a limited but reasonable amount of coordination with other Federal agencies and with industry. After a period of use, Interim Federal Specifications will be fully coordinated with Federal agencies and with industry, and may be converted to Federal Specifications, mandatory for use by all agencies of the Government.

The GSA regulation provides for the development of Federal Standards and makes their use mandatory by Federal agencies, with limited specified provisions for taking exceptions with the approval of GSA.

Through June 30, 1954, GSA had issued 46 Federal Standards covering items which the Government procures in large volumes. A total of 859 items have been eliminated by these Federal Standards. In such areas as office and janitorial supplies and general office furniture, and for items such as electric fans, 82 per cent of the items in varying former use have been eliminated from the Federal supply system. Excess stocks of "nonstandard" items will be used up, of course, before the standard items become a part of new procurements.

The GSA regulation prescribes the method of development and use of qualified products in those areas where the testing of deliveries under requirements of the Federal specification would cause undue delay or use of expensive or complicated testing apparatus not commonly available, where performance data are required, or where the Government requires assurance prior to award that the product is satisfactory for its intended use.

The development of Federal Qualified Products Lists is assigned to Federal agencies, and it is the responsibility of the assigned agency to designate a qualifying activity to handle the details of the qualification testing.

Assistance by Industry

More and more, industry will be consulted in the development of specifications and standards. It is GSA's aim to make specifications and standards increasingly clear and simple through the use of uniform terminology accepted by both Government and industry, through specifying functional or performance requirements rather than "how" a product is made, and through increasing the participation of industry in the Government's supply program.

Technical societies and trade associations have been called upon, and will continue to be called upon, to review Federal specifications which, because of the time elapsing since their issuance or for other reasons, are believed to require revision.

WILLIS S. MACLEOD, since 1945 Director, Standards Division, General Services Administration, has had extensive experience in the field of standardization in the petroleum industry and in war and postwar government service.

In connection with the increased consultation with industry required by the regulation, GSA will establish, as required, technical committees and conferences of technicians from industry, technical societies, and trade associations. For years the Government has been precluded from having technical society and trade association specialists on such industry groups. Last December, however, the Justice Department concurred in issuance of an internal GSA directive prescribing the circumstances under which industry personnel can participate in technical advisory groups. The GSA regulation on specifications and standards encourages other Federal agencies to take advantage of the facility for arranging technical advisory groups in connection with the development of specifications and standards.

Promulgation of Federal Specifications and Standards by GSA

Federal Specifications and Standards will be promulgated by GSA. Before approval and promulgation, GSA will review them to assure that the comments of Federal agencies have been properly incorporated or reconciled. In some instances, it will be necessary for the assigned agency or GSA to hold conferences with agencies and industry in further development before the specification or standard is ready for promulgation for mandatory use.

It can be seen, therefore, that although the responsibility for developing Federal and Interim Federal Specifications and Standards, and for issuing Interims, will be placed on other agencies consenting to such assignments, GSA has the over-all responsibility for Federal Specifications and Standards. The candid comments of Federal agencies and of industry on the need for amending or revising specifications will be most helpful to GSA in doing its job.

In this connection, a further policy has recently been adopted in GSA to encourage suppliers to recommend substitute items offering the same or better service at lower cost than those covered in existing specifications. This is done by including in invitations to bid a statement to the effect that suppliers are urged to recommend to the Standards Division of the Federal Supply Service, GSA, similar products they can supply, which, while precluded by one or more of the provisions of the cited Federal Specifications, will in the opinion of the supplier provide equal or better serviceability or improved performance at the same or lower cost. Consideration can then be given specification revisions for future invitations.

Summary of the GSA Regulation on Specifications and Standards

The GSA regulation on specifications, standards, and qualified products lists was issued under Title 1, Personal Property Management, Regulations of the General Services Administration, and is Part 2 of Chapter VI, Commodity Standardization. A summary of part 2, its format, principal policies, and procedures is given below.

Format

PART 2 SPECIFICATIONS, STANDARDS, AND QUALIFIED PRODUCTS LIST

Section 201.00—General (scope, definitions, availability).

Section 202.00—Development of Federal and Interim Federal Specifications (assignment, schedules, basic requirements, responsibility of assigned agency, items peculiar to an individual agency, preparation and processing, review and promulgation, amendment, revision, cancellation, and printing and distribution).

Section 203.00—Use of Specifications (mandatory and optional, construction contracts, departmental).

Section 204.00—Development of Federal Standards (objectives, initiation, standardization studies, material to be covered, schedules, responsibility of assigned agency, coordination, review and promulgation, changes, cancellation, conversion of departmental standards, and printing and distribution).

Section 205.00—Use of Federal Standards (mandatory use and application).

Section 206.00—Development and Use of Federal Qualified Products Lists (definitions, assignment, justification, qualification, notification to the manufacturer, costs, preparation, processing, review and issuance, extension of qualification, removal, use, restrictions on use, revisions and amendments, cancellation, inquiries, and recommendations).

APPENDIX C

Exhibit 14—Flow Chart for Development of Federal and Interim Federal Specifications.

Exhibit 15—Outline of Form for Preparation of Federal and Interim Federal Specifications.

Exhibit 16—Federal Qualified Products Lists Summary—Provisions Governing Application by Manufacturers for Inclusion on Federal Qualified Products Lists.

Exhibit 17—Instructions for Preparation and Processing of Federal Qualified Products Lists.

Policies

The policies established by the Regulation on specifications, standards, and qualified products lists are principally these:

1. *Mandatory and Optional Use. Federal Specifications* are mandatory for use by all Federal agencies. *Interim Federal Specifications* are mandatory for use by the agencies specified in the preamble and optional for use by other agencies. General exceptions, pursuant to statutory authority, public exigency, and other conditions, may be applied in the use of mandatory specifications.

   Deviations from Federal Specifications, if not provided for under general exceptions, must be reported to GSA if they (*a*) are taken repeatedly, (*b*) indicate that the specification should be revised or amended, or (*c*) result in the entrance of a new item into the supply system as evidenced by the development of a new item identification. Deviations reported may be continued until notified to the contrary by the Administration.

   Deviations from Interim Federal Specifications are to be reported wherever mandatory use is specified. All agencies are urged to use and comment on Interim Federal Specifications. Reports of deviations and comments will be used by the assigned agency in revising the specification.

   Federal Standards are mandatory for use by all Federal agencies.

   Deviations from Federal Standards may be taken by an agency only with the approval of GSA, except where general exceptions may be applied as in the case of Federal Specifications.
2. *Essential needs of Federal agencies* shall be considered.
3. *The number of types and varieties* shall be held to the minimum consistent with over-all efficiency and economy.
4. *Full consideration shall be given to end use and economy.*
5. *Standardization in commodity areas involving large-volume purchasing* will be emphasized to insure purchase of only such items as meet, and do not unreasonably exceed, essential requirements of Government.
6. *Functional or performance requirements* rather than design, construction, or compositional requirements shall be specified.
7. *Interchangeability of parts and replacement of components* shall be facilitated through the greatest practicable degree of uniformity of dimensions or other characteristics.
8. *Uniform terminology and definition of technical practices and processes* shall be adopted.
9. *Industry shall be encouraged to participate* in the Government supply program.
10. *Nationally recognized industry specifications and standards* shall be used and adopted to the maximum extent practicable, and *credit* shall be given to the industry for the use or adop-

tion of such specifications and standards.

11. *Products of standard commercial construction* manufactured for general commercial use shall be required in specifications and standards to the maximum extent consistent with Government requirements.
12. *Requirements for the manufacture, preservation, packaging, packing, inspection, and acceptance of items shall be uniform* to the maximum extent consistent with the varying needs of Federal agencies. Such requirements shall be adequate but not unreasonably in excess of the quality of the product or the level of protection necessary.
13. *Departmental specifications* of use to two or more Federal agencies, one of which must be a civil agency, shall be converted to Interim Federal or Federal Specifications. This conversion will be effected following agreement with Federal agencies having interest.
14. *Consideration shall be given to the conservation of critical materials.*

Procedures

To advance the policies established, detailed procedures have been made a part of the regulation. These procedures require that:

1. *Interim Federal or Federal Specifications and, as applicable, Federal Standards* will be developed for items in which two or more Federal agencies are interested. One of the agencies having interest must be a civil agency.
2. *Assigned agencies will have full responsibility* for the development of Interim Federal and Federal Specifications except that Federal Specifications will be subject to review by GSA before promulgation. Review by GSA will be for the purpose of determining compliance with policies and procedures and, when necessary, reconciliation of conflicting recommendations of Federal agencies.
3. *Interim Federal Specifications will be developed through consultation with Federal agencies prior to issuance* except where immediate procurement needs make such coordination impracticable. Consultation before issuance will be for the purposes of (*a*) developing a reasonably adequate specification in less time than would be required for a Federal Specification, and (*b*) providing opportunity for use of and comment on such a specification before it is promulgated as a Federal Specification.
4. *When circumstances so warrant* Interim Federal Specifications may be issued without consultation with other Federal agencies.
5. *Opportunity to comment* on each Specification proposed for conversion to a Federal Specification, or on the draft of a proposed Federal Specification which has not been initially issued as an Interim Federal Specification, will be given Federal agencies and industry prior to promulgation of the applicable Federal Specification. These comments and all other comments and reports of deviations will be taken into consideration in preparing the final draft of the Federal Specification.
6. *Consultation* of Federal agencies with each other and with industry will be carried on as necessary. *Where interdepartmental working committees or conferences* are to be established, the approval of GSA is required. If *industry participation* is involved in committees or conferences, the assigned agency must apply safeguards consistent with criteria established by the Department of Justice to insure against violation of antitrust laws.

   GSA has established procedures for internal use in establishing and conducting technical committees and conferences which provide for participation of technicians from industry, technical societies, and trade associations. These procedures, concurred in by the Department of Justice, were issued under GSA Administrative Order No. 153, dated December 18, 1953.

   To the extent that staff and facilities permit, GSA will, upon request of the assigned agency, consider the need for technical committees and conferences in connection with the development of specifications and standards, to be established in accordance with the above Administrative Order.
7. *Specifications will be revised, amended, or canceled under the same general procedures* as those applying to the development of a Federal or Interim Federal Specification.
8. *Interim Federal Specifications will be issued by the assigned agency.* Upon issuance, the agency will send three copies to GSA; GSA will reproduce the specification to provide sufficient copies for use of Federal agencies and industry.
9. *Federal Specifications and Standards will be promulgated by GSA* and distributed to Federal agencies.

P. F. Rice New ACI Technical Director

The American Concrete Institute has appointed Paul F. Rice as its Technical Director. Mr. Rice's duties will include field and office work to promote technical relations with other societies, assist member groups in organizing and conducting meetings, and aid technical committees in the preparation of reports.

Unpunched IBM Index Cards

Unpunched IBM index cards are now available from ASTM Headquarters in carton lots at $6.50 for a carton of 2000 cards.

Previously unpunched IBM index cards for the X-ray diffraction data were not available from ASTM Headquarters. Hence those users of the cards who had data of their own to index were either obtaining unpunched cards from the Wyandotte Chemicals Corp. or negotiating directly with their local IBM office.

ERRATA

ASTM Standards on Copper and Copper Alloys (September, 1954, Edition).—A printer's error has occurred in the Standard Specification for Copper-Nickel-Zinc Alloy (Nickel Silver) Wire (B 206–54) as printed in the September, 1954, edition of the special publication "ASTM Standards on Copper and Copper Alloys." On p. 337 in Table I covering chemical requirements the permissible lead content for alloy D should be changed from "0.50 max" to read "0.05 max" per cent.

ASTM Specifications for Rolled Structural Steel (September, 1954, Edition).—A printer's error has occurred in the Tentative Specification for General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use (A 6–54 T). On p. 11 under Table XI the first sentence should be corrected to read "The permissible variations given in the above table apply to plates which have a specified minimum tensile strength of not more than 60,000 psi, or equivalent hardness."

Spectroscopy Papers Invited

The American Association of Spectrographers is planning their 6th Annual Conference in Chicago, Ill., May 6, 1955, on the subject "Industrial Applications of Spectroscopy." Contributed papers in the fields of emission, X-ray fluorescence, or absorption spectroscopy as applied to industry are invited.

Abstracts must be submitted by March 1, 1955.

Address inquiries to:

F. E. Stedman or E. E. Stilson, Co-Chairmen, Engineering Research Laboratory Bendix Products Div. Bendix Aviation Corp., 401 North Bendix Drive, South Bend 20, Ind.

ASTM Bulletin

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NO. 202

NINETEEN-SIXTEEN
RACE STREET
PHILADELPHIA 3, PENNA.

Concerning Government and Industry Standards

THERE have been several significant developments in the Washington scene concerning the development of Government standards. In this BULLETIN (page 13) is an interesting article by Willis S. MacLeod, Director, Standards Division, General Services Administration, on a recent directive concerning the development and revision of Federal specifications which are the province of the GSA. It is hoped each ASTM member will read this article because it sets forth the philosophy and mechanics of this most important Government activity.

It should be noted that the former Federal specifications committees no longer exist and that GSA assigns to appropriate Government departments the task of developing new or revising current specifications.

On October 15, 1954, Secretary of Defense Charles E. Wilson signed a very significant directive setting forth the philosophy and policy of the Defense Department concerning standards. It too is of much concern not only to ASTM and its technical committees but to industry as well.

One might ask why ASTM and its committees are vitally concerned with these matters. One simple answer is this, that the ultimate aim of standardization is not achieved simply when ASTM issues a specification or a standard test method. Only when that document is widely used will the maximum benefits come from the extensive efforts by our country's leading authorities, and this includes not only the top technical people in industry but capable representatives from Municipal, State, and Federal departments as well. Industry benefits when there is a minimum of duplicating specifications. Various departments of the Government likewise can benefit when industry standards can be applied; all of the economies they embody can be made use of by the Government

Coordination of Industry and Federal Specifications

We think it highly significant that the GSA order and the Department of Defense directive embody by direct statement as well as implied philosophy the use of industry standards whenever possible, and the coordination of Federal and military specifications with those issued by such organizations as ASTM.

The officers and members of the Society feel strongly that there should be a maximum of correlation and coordination, that where industry standards are available that are equivalent or very similar to Federal or Defense the latter should so indicate, and that the lists and indexes of standards should carry cross references. Obviously, there are many materials and products purchased by the Government where special properties or special requirements are justified, but there are hundreds of cases where a basic industry standard could and should serve.

It is important that the various Government departments should be very adequately represented on industry groups that are preparing standards and, conversely, the industry groups should be more cognizant of activities in the Government departments. It is felt that the new directives are an important step in this direction.

Through a Special Committee on Government Contacts, headed by ASTM President Mochel, with Messrs. Schatzel, Fowler, and Parsons as members, and with the assistance of the Staff, several conferences have been held and contacts made with responsible Government officials. Mr. Roger Hepenstal, Director, Cataloging, Standardization, and Inspection, Department of Defense, reporting directly to the Assistant Secretary of Defense Logistics and Supply, Mr. Pike, knows of the great concern of the Society in the work he is directing; and there have been various discussions with Captain C. R. Watts (USN), Staff Director for Standardization, DOD, concerning his significant work. The Society, through its committees, is at all times willing and anxious to cooperate in coordinating activities.

Results of ASTM and Government Cooperation

There is one outstanding example of what can come about when, under appropriate auspices, technical men in Government and in industry sit down around the table and compare notes on standards. Our Committee D-2 on Petroleum Products and Lubricants has had for some years a contact group headed by L. C. Burroughs of Shell Oil Co. that has devoted much time and effort discussing with Federal and Defense officials the correlation of the petroleum test methods with Federal requirements. Of some 120 standards in the Federal document VV-L-791E, about 75 are the same. Putting it pagewise, of the 437 pages in the Federal document, 284 are the same as ASTM. We think this is very commendable. It entails considerable work, and the task is an unending one to keep the methods in line with new developments and latest practice.

Recently Committee D-1 on Paint, Varnish, Lacquer and Related Products has designated J. C. Moore of the National Paint, Varnish and Lacquer Assn. as a liaison between the committee and the Federal work in this field. We feel confident that constructive results will come from his contacts.

There may be other areas where similar coordinating work can be productive and benefit the Government and industry.

It would seem highly important that the technical representatives of the Federal Government, whether from the Department of Defense or other departments concerned with Federal or military standards, should have the opportunity to attend technical meetings and participate in discussions on specifications and tests. We think it significant that after several years another Department of Defense directive clarifies the voting status of the Government representatives, permitting them to vote on letter ballots affecting technical matters. There is a brief news item concerning this

development also on another page (page 19).

In appraising these recent developments one might feel extremely optimistic, but considering the immensity of the problems involved it is not too wise to feel that the entire picture is extremely rosy. Specifications, by their very nature, come about slowly and changes likewise, and when there is a Government practice that has been ingrained for many years, time is of the essence in effecting changes.

We feel confident, however, that with the backing of their superiors (Messrs. Mansure and Mack in the General Services Administration and Messrs. Wilson, Anderson, Pike, Newbury, and Quarles in the Department of Defense), Mr. MacLeod and Captain Watts will be able to report continuing progress. They have effected a close liaison between the work on Federal and military specifications and that of itself is a real achievement. We hope that the members of ASTM in industry will give full support to this coordinating work.

It is confidently expected there will be more to report from time to time concerning correlation of industry and Government standards.

Frank Y. Speight Joins Headquarters Staff

ON NOVEMBER 1 Frank Y. Speight became a member of the ASTM Headquarters Staff in Philadelphia as Assistant Technical Secretary. In this capacity he will assume responsibility for Staff contacts with a number of technical committees and will also assist the Editor in various publication matters.

Born in Georgia, Mr. Speight attended Georgia Institute of Technology, but received his degree of B.S. in Chemical Engineering from Alabama Polytechnic Institute in 1938. He later took courses in the Yale University Extension School and in George Washington University.

Most of his experience has been in two organizations, first, American Cyanamid Co. both at a plant in Georgia and later at the research laboratories in Stamford, Conn. For several years, he has been Assistant to the Executive Director for the Advisory Board on Quartermaster Research and Development which functions under the National Academy of Sciences–National Research Council. In this capacity he has had many contacts with ASTM and its committees.

His training and experience will provide a good background for some of his immediate assignments in the Staff. Among the committees which he will follow as contact man will be Committee D-9 on Electrical Insulating Materials and D-20 on Plastics. He is a member of the latter group. Other committee assignments will be made from time to time. In his work with the National Research Council he has had considerable editing and publication experience which can be usefully applied in helping to carry the increasing load of editorial and publication work in the Society.

Please Pay Your Dues Promptly

IN FOLLOWING a suggestion from our Bookkeeping and Membership Record Departments, we feel the situation is somewhat like the pastor who strongly exhorted his members at church service to attend. Actually the people who should hear him are the ones who are away.

Probably a good percentage of those who peruse this short article are ones who do pay their dues promptly and thus make life somewhat easier for our Bookkeeping and Membership Record Departments. It is surprising the amount of effort entailed in following up those members who for various reasons, some perhaps good and sufficient, do not pay their dues promptly. In April, and again in June, letters go to the members reminding them that we are most anxious for them to continue their membership and requesting them to remit their dues.

The officers of the Society are most anxious that every member shall keep his membership current and thus benefit from the extensive publications and the other services rendered. The paying of dues early in the year following receipt of the statement sent January 1 is most helpful.

For those, and we hope there are very few indeed, who have no intention of doing so, and have made up their minds to relinquish their membership, a note to that effect also would be helpful. There is bound to be some turn-over in our membership as men change occupations and responsibilities, and as companies start new or relinquish older lines of work.

Please keep your membership in good standing—early payment of dues is helpful and conserves our man-hours.

Defense Department Clarifies Status of Representatives

IN A directive dated September 13, 1954, R. D. Anderson, Deputy Secretary of Defense, clarified the status of representatives of the Department of Defense who participate in the activities of nongovernment organizations, including technical and professional societies. In essence this directive reverses previous policy and permits the representatives to vote verbally or in writing on issues that are presented. The Society is gratified that this decision has been reached.

For many years prior to 1940 the representatives of the military participated fully and freely in ASTM meetings, in exchanging correspondence, and by return of letter ballots on technical matters affecting standards. The opinions of the Government representatives have carried considerable weight and have been constructive in making the ASTM specifications and tests as widely applicable as possible. In recent years, under rulings by various officials, voting on ballots was either discharged or forbidden.

Considering that the use of ASTM standards is distinctly a voluntary one, it did seem that the representatives of the various military departments, provided those departments and individuals wished to, should have been able to execute letter ballots.

Copies of the new directive have been sent to the officers of the ASTM technical committees. While there are certain limitations in the order, for example, participation in the management and control of organizations cannot be maintained without Congressional authorization, the directive does make clear that representatives, while participating in the activities of technical and related organizations, including technical committees and standards committees, may give free and complete expressions of their views and may vote verbally or in writing.

The directive relates specifically to official participation of representives of the Department of Defense, but it also points out that individuals may hold membership and participate in the work personally apart from official representation. There are many individuals in Government service who do hold personal membership in ASTM and serve as individuals on committees.

The new directive, No. 5500.2, cancels a previous statement by the Munitions Board dated May 27, 1948.

Concerning the National Bureau of Standards . . .

ASTM Interest—Advisory Committee—Testing and Research—Adequate Appropriations

THERE can be no question that ASTM is vitally concerned with the work of the National Bureau of Standards. Ever since the Bureau was organized in 1901, there has been close collaboration of the two organizations in many activities.

Considering this it may have seemed strange that we have not commented publicly nor adopted a particular policy with respect to the investigation of NBS carried on by the committee headed by Dr. Kelly. There was included in the BULLETIN a news account of the report on the battery additive controversy presented by the special committee headed by Zay Jeffries, a former Director of ASTM.

Absence of public comment has not been due to a lack of interest in the society, because in meetings of the Directors, in private conferences, and in discussions with various officers, the representatives of the Society have expressed themselves clearly in support of the Bureau.

Close Contact with ASTM

It is correct to say that no professional or technical organization in this country has had closer or more extensive contacts with the Bureau than ASTM. This stems naturally from the interest of the two groups in the work on materials, standards, and research. There are currently upwards of 100 Bureau members who are affiliated with ASTM and a number of others, in addition, who participate actively in committee work. The Bureau has been a heavily drawn on reservoir of competent men to serve as chairmen of many of our important technical committees.

Three Bureau officials have received the Society's highest honor—the Presidency—George K. Burgess, Bureau Director; G. E. F. Lundell, Chemistry Division Head; and P. H. Bates, Chief, Silicate Products Division. There have been several ASTM Directors from the Bureau, and it is currently represented on the Board by D. E. Parsons, Chief, Building Technology Division.

The Society has published dozens of technical papers by Bureau personnel, many of which have received awards. A great mass of important research data has been supplied to ASTM committees by Bureau investigations, and the counsel of the outstanding technologists comprising the Bureau staff has been most helpful in arriving at appropriate decisions concerning the Society's test methods and standard specifications.

In short, the Society is greatly indebted to the National Bureau of Standards for sustained and most valuable support of its work.

The Bureau, on the other hand, no doubt feels that its personnel has benefited from rubbing elbows with America's leading industrial testing and materials experts who represent the producing or consuming viewpoints. The Society has, through research associates or directly, sponsored numerous research projects at the Bureau. A notable example of such collaboration is the ASTM-NBS Cement Reference Laboratory, the unique project jointly financed, and carried on at the Bureau. This Laboratory has helped to establish and maintain a high level of quality performance in the cement testing laboratories of both the consumer and the producer.

What about the situation concerning the Bureau that obtained during recent months? Many of our officers and members were quite concerned that the Society was not represented on the committee requested by Secretary Weeks, and selected by Dr. Bronk and Dr. Kelly. Nine professional societies each designated a representative with a preponderance of well known, highly respected university men. Nevertheless, several men on the committee had some knowledge at least of the Society's interest and, it is hoped, its obligations. Perhaps in the light of developments it is well that ASTM was not asked to participate.

ASTM Advisory Committee

However, it is gratifying that because of the Society's interest we were asked to arrange a special Advisory Committee to the Bureau along with the advisory committees designated by the other Kelly committee participants, and it is expected the ASTM group will undertake intensive study of various matters related to its work. This means evaluation of the Bureau's testing program, certain work on specifications, and standards, the question of calibration of instruments and the like, development of chemical standards and spectrographic standards (in the latter field ASTM has published several of the Bureau's reports) and in other areas. The ASTM committee is quite representative of the Society's activities (N. L. Mochel, President; A. Allan Bates; T. A. Boyd, Past-President; Aiken Fisher; and R. E. Peterson; see accompanying news article).

Certain ASTM committees concerned with instruments have addressed resolutions to the Board expressing great concern lest important calibration work carried out at the Bureau for years on thermometers, laboratory glassware, etc., be discontinued. The Scientific Apparatus Makers Assn. (SAMA) is on formal record urging the continuance of this work. Such expressions need careful and thorough evaluation.

One of the serious problems now facing the Bureau—and we should stress that, like ASTM, the Bureau is not a cold pile of stone or publications but people—is the lack of sufficient appropriation, not only to continue work, but to expand it in areas where there is definite need. It is expected the advisory committees will consider this problem.

Adequate Financial Support

One remedial measure might be the grant by legislative action of authority to the Bureau to retain in its operations the moneys received from calibration and related activities. This money now goes into the U. S. Treasury. Senator Bricker introduced at the last session of Congress a bill intended in part to rectify this situation. While the Society took no specific position on this bill, the ASTM Directors at their meeting on September 21 affirmed unanimously the desirability of providing adequate financial support for the Bureau. This principal will continue to receive full support. What specific actions can be taken must be resolved.

It is clear that the Congress must be impressed with the great significance to our economy of having adequate scientific and technical data. And many feel that the Bureau should intensify its research activities. This is the general tenor of the Kelly Report which suggests that in at least several divisions of the Bureau, repetitive testing work be evaluated. It is not the purpose of this article to evaluate the Kelly Report which represents the intensive efforts and great amount of time of men who certainly have the welfare of this

country as the primary concern. There are some in industry who feel that the Bureau should concentrate more on the development and maintenance of standards of weight, measurement, etc. Probably, as in many cases, a middle road will be found.

It is not good for the Bureau personnel nor for the scientific and engineering fraternity as a whole, to have situations arise such as have plagued Dr. Astin and his associates in the past year and a half. He has been, and should be, complimented for the firm stand he took concerning the battery additive situation, and subsequently for his very close cooperation with the committee that has been studying the Bureau operations.

We do not expect that the Advisory Committees, or the intensive work that Dr. Kelly has himself personally devoted to this cause, or other activities at the Bureau are suddenly to solve all of the Bureau's problems. But we feel confident that if those who should know, learn more of the Bureau's operations, and give their support, constructive action will result.

And regardless of these controversies the Society will continue fully to support the Bureau.

ASTM Advisory Committee Appointed to National Bureau of Standards

A SPECIAL ASTM Advisory Committee to the National Bureau of Standards has been appointed by President N. L. Mochel, in consultation with A. E. Astin, Director of the Bureau. This committee will study various phases of the Bureau's work that tie in closely with ASTM activities and with the various recommendations and data in the Kelly Report, and will provide counsel to the Bureau on various aspects of the work.

In selecting the personnel of the committee an effort was made to have representation from various industries and professions and representing a variety of administrative responsibilities. The personnel is as follows:

A. Allan Bates, Vice-President of Research and Development, Portland Cement Assn., Chicago, Ill.

T. A. Boyd, Research Consultant (Retired), General Motors Corp., Detroit, Mich.

Aiken Fisher, President, Fisher Scientific Co., Pittsburgh, Pa.

N. L. Mochel, President, ASTM

R. E. Peterson, Manager, Mechanics Division, Westinghouse Electric Corp., Pittsburgh, Pa.

The committee members will have staggered terms, but each president of the Society will automatically become a member, serving for one year.

The Executive Secretary of the Society will participate in the discussions and assist the committee.

This committee is one of several designated by professional and technical societies in accord with the recommendations contained in the report of the so-called Kelly Committee which, in October, 1953, submitted to Mr. Weeks, Secretary of Commerce, its conclusions based on an exhaustive study of functions and operations of the Bureau. Although ASTM was not represented on the committee which included members recommended by nine professional societies, the Bureau, Dr. Kelly, and officials in the Commerce Department felt there should be an ASTM study group because of the great interest and concern of ASTM in the Bureau's work.

Schedule of ASTM Meetings

This gives the latest information available at ASTM Headquarters. Direct mail notices of all district and committee meetings customarily distributed by the officers of the respective groups should be the final source of information on dates and location of meetings. This schedule does not attempt to list all meetings of smaller sections and subgroups.

DATE	GROUP	PLACE
Jan. 24	Chicago District Meeting—Joint with Western Society of Engineers	Chicago, Ill.
Jan. 24–26	Committee A-1 on Steel	New York, N. Y. (Warwick Hotel)
Jan. 24–25	Committee B-1 on Wires for Electrical Conductors	New York, N. Y. (ASA Headquarters)
Jan. 25	St. Louis District Meeting—Joint with Mo. Soc. of Professional Engineers	St. Louis, Mo.
Jan. 27–28	Committee B-4 on Electrical Heating, Electrical Resistance and Electronic Applications	New York, N. Y. (Gov. Clinton)
Jan. 31–Feb. 4	**ASTM Committee Week**	**Cincinnati, Ohio (Netherland-Plaza Hotel)**
Feb. 8	Southwest District Meeting—Joint with ASM, ASME, Eng. Club of Bartlesville	Bartlesville, Ohio
Feb. 10	Denver District Meeting—Joint with ASM	Denver, Colo.
Feb. 13–18	Committee D-2 on Petroleum Products and Lubricants	Houston, Tex. (Rice Hotel)
Feb. 14	Richland District Meeting—Joint with ASM	Richland, Wash.
Feb. 15	Tacoma District Meeting—Joint with ASM	Tacoma, Wash.
Feb. 16	Seattle District Meeting—Joint with ASM	Seattle, Wash.
Feb. 23	Northern California District Meeting	San Francisco, Calif.
Feb. 24	Southern California District Meeting	Los Angeles, Calif.
Feb. 24–25	Committee D-6 on Paper and Paper Products	New York, N. Y. ASA Headquarters
March 1	Southwest District Meeting—Joint with ASM	Houston, Tex.
March 3	Southwest District Meeting—Joint with ASM	Dallas, Tex.
March 14–15	Committee D-12 on Soaps and Other Detergents	New York, N. Y. (Park-Sheraton Hotel)
March 15–18	Committee D-13 on Textile Materials	New York, N. Y. (Statler Hotel)
March 31–April 1	Committee D-14 on Adhesives	New York, N. Y. (ASA Headquarters)
April 21–22	Committee D-10 on Shipping Containers	Madison, Wis. (Forest Prod. Lab.)

District Activities

President Mochel Addresses Three District Meetings

PHILADELPHIA

President Norman L. Mochel, speaking before his "adopted" ASTM district of Philadelphia (he considers Pittsburgh his home district), held for more than an hour the attention of an audience of almost 200 engineers and engineering students and faculty members in the Auditorium of the Drexel Institute of Technology on October 13.

Mr. Mochel's address, "Power and Materials, Now and in the Future—Some Metals and Materials Problems," traced the development of the steam turbine from its initial conception in the 17th century up to the present time. The President discussed the problems pertinent to the development and construction of the largest turbine yet planned; a double reheat turbine using steam at 5000 psig and 1150 F, which will generate 275,000 kw.

Student Membership Prizes

One of the features of this meeting was the presentation of Student Membership to 28 students, 24 of whom were the dinner guests of the Philadelphia District Councilors.

The Philadelphia District starting this year, will sponsor annually 23 Student Membership Prize Awards at nine of the ten colleges in the Philadelphia District offering engineering courses. Five additional awards, the Warwick Memorial Awards at the University of Pennsylvania, are cosponsored by President Mochel and Executive Secretary R. J. Painter. The recipients of the Student Membership Prize Awards for 1954–1955 in the Philadelphia District are as follows:

University of Delaware
Albert N. Garthwaite
Thomas R. Williams

Drexel Institute of Technology
Ronald L. Drake
Ralph G. Berglund
Lawrence I. Lady
Jerome M. Schmerling
Robert D. Faccenda
Nathaniel Steinberg

Lafayette College
Joseph H. Hayden
Joseph W. Drosdick

Lehigh University
Raphael S. Aronson
William J. Wessner, Jr.
John B. McVey, Jr.
Clarence James Walbert, Jr.

Bucknell University
Natale Fruci
Otto C. Davison

Philadelphia Textile Institute
Wallace Nuttall
Donald Hartzell

Princeton University
Roger MacDonald Barr
Paul Reid Slimmon

Swarthmore College
Horace A. Reeves, Jr.

Villanova University
Joseph W. Distel
Stephen A. McGlynn

University of Pennsylvania
Frederick Harold Hull
Richard S. Marcus
John Ancora Martin
Russell P. Heuer, Jr.
Gerson H. Goldstick

The success of the student aspect of the meeting was due in large part to the efforts of Miss Edna Harvey of the ASTM Staff. Miss Harvey contacted the schools, advised the students designated, and took care of other pertinent details of the Student Membership Prize Award program.

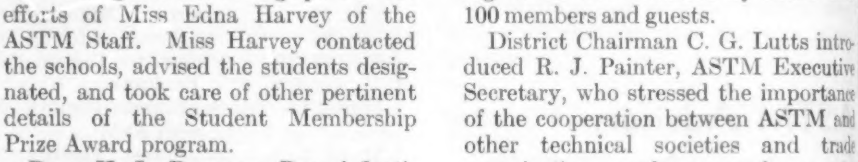
Dean H. L. Bowman, Drexel Institute of Technology, in welcoming the group, expressed his appreciation of the work that the ASTM is doing in the field of engineering. Professor L. P. Mains, Head of the Drexel Department of Civil Engineering, acted as program chairman of the evening introducing President Mochel, Philadelphia District Chairman E. K. Spring, and R. J. Painter, who in awarding the Student Membership Prize Certificates, stressed the interest of the ASTM in engineering education.

NEW ENGLAND

At the October 28 meeting of the New England District in Cambridge, Mass., President Mochel shared the rostrum with Junius W. Millard, Chief, Mechanical Engineering Div., Quartermaster Research and Development Center.

A dinner preceded the technical meeting which was attended by more than 100 members and guests.

District Chairman C. G. Lutts introduced R. J. Painter, ASTM Executive Secretary, who stressed the importance of the cooperation between ASTM and other technical societies and trade organizations, and expressed apprecia-



At the Philadelphia District meeting, left to right, seated: ASTM Executive Secretary R. J. Painter; District Vice-chairman Tinius Olsen; President Mochel; District Chairman E. K. Spring; ASTM Director A. O. Schaefer and District Vice-chairman L. D. Betz. Standing: District Secretary A. H. Kidder; L. P. Mains; Past President H. L. Maxwell; Drexel Institute Deans Bowman and Riddle.

tion of the strong support given the Society and its work in materials by the New England District.

H. H. Lester, program chairman, also referred to the New England contingent's concern with materials and pointed out that ASTM is unique among technical societies in making the development of specifications and methods of tests for materials a primary function. Mr. Lester also showed that the President's talk which followed would not have been possible without the marked improvement through the years in metals for elevated temperature use.

Mr. Mochel illustrated his talk, "Power and Materials, Now and in the Future—Some Metals and Materials Problems," by references to early installations of steam turbines in the New England area.

Mr. Millard described the organization and research facilities of the new Quartermaster Research Center at Natick, Mass. A separate article on this important research establishment appears on page 36.

PITTSBURGH

In Pittsburgh on October 26 President Mochel spoke to a joint meeting of ASTM and the Pittsburgh Section of the Society of Automotive Engineers.

About 80 persons attended the presession dinner at Webster Hall presided over by H. K. Siefers, United Oil Co., chairman of the SAE Pittsburgh Section, who introduced the officers of the SAE local section and of the ASTM Pittsburgh District Council.

ASTM District Chairman Henry A. Ball, Ball Chemical Co., presided at the technical session, at which there were about 100 in attendance. He introduced the ASTM Executive Secretary, R. J. Painter and the ASTM President.

Mr. Mochel prefaced his technical talk by indicating his pleasure in speaking as a president in the city where he had been born and reared. While the general basis of his talk was the subject "Power and Materials, Now and in the Future," he stressed the significance of electrical energy, particularly in its tremendous growth and what experts think the future has in store. He used the recent East Coast hurricanes as an example of how dependent upon electrical energy we have become and the great inconvenience resulting from power failure.

He also discussed some of the giant turbines with outputs of 250,000 and 275,000 kw now under construction or in the drawing board stage. These involve tremendous problems in supplying the forgings and other material requirements. There was an interesting discussion period and general comment on relation between gas-turbine and steam-power facilities. It was stressed that in each situation careful study must be made of such factors as location, available fuel, future load, etc.

ST. LOUIS

"Application of Radioactive Tracers in Metallurgy" is a currently important subject as evidenced by the attendance of more than 160 engineers and scientists at a joint meeting of the ASTM St. Louis District, the local ASM Chapter, and the Engineers Club in St. Louis on October 14.

L. M. Foster, Assistant Chief, Physical Chemistry Div., The Aluminum Company of America, Research Laboratories, discussed the factors which cause a material to be radioactive, giving a résumé of atomic configuration, that is, the fact that an atom consists of protons, electrons, and neutrons and the relationship in size of the electron to the proton.

He then described an atomic pile and the procedure for making a material radioactive, also, the length of time of exposure within the pile and the resultant life or half life of the material. Private industry, in order to have materials radioactivated by the Atomic Energy Commission for laboratory use has to pass certain requirements. One of these requirements is the demonstrated ability to handle "hot" materials and to dispose of radioactive wastes.

Finally, Dr. Foster dealt with the uses of these activated materials in experiments in measuring tool wear machining aluminum, metal flow, and analyses of aluminum including gaseous inclusions, and corrosion. Following his talk a lively question and answer period ensued which elaborated on many of the points discussed by Dr. Foster in his paper.

OHIO VALLEY

Carl A. Ludeke, Associate Professor of Physics, University of Cincinnati, Cincinnati, Ohio, addressed more than 250 members of ASTM and the Technical Association of the Pulp and Paper Industry at a joint meeting held in Dayton, Ohio, on October 7.

Dr. Ludeke devoted a goodly part of his speech "Atomic Energy in Industry," to the early developments in nuclear physics, beginning with the discovery in 1897 that cathode rays are composed of particles rather than rays such as light rays. He went on to discuss the progress made in atomic energy since Fermi developed the first atomic pile in Chicago in 1942. Just ten years after this beginning of the atomic energy period the Duquesne Power and Light Co. in Pittsburgh in 1952 made plans to build its own nuclear reactor for power development. Dr. Ludeke pointed out the essential difference between hydrogen and atomic reactions; the former is a fusion process as compared to fissioning in the A-bomb. It is of interest to note that in the A-bomb

At the speaker's table, Ohio Valley District-TAPPI meeting are, left to right: H. R. Joiner, chairman, Ohio TAPPI Section; the speaker, Dr. Carl A. Ludeke; Virgil Perry, chairman, TAPPI Program Committee; J. S. Pettibone, ASTM Staff; R. S. Armstrong, vice-chairman, ASTM Ohio Valley District.

only about $\frac{1}{1000}$ of the potential energy is liberated. The initial reaction distributes the remaining mass so that the fissioning process cannot continue.

In discussing the Duquesne nuclear reactor, Dr. Ludeke presented some interesting figures such as the fact that the coolant will be water at 500 F and 200 psi; the power output is expected to be 1000 kw per 1000 g of fissionable material.

With the advent of atomic power it is possible that the present economic balance throughout the world will be rearranged inasmuch as countries presently short of power could by the use of atomic reactors become competitors of countries at present having large sources of natural power.

A number of ASTM councilors were present from the Ohio Valley District, including Past-Chairman J. C. Harris and Messrs. D. S. Bruce, R. D. McGill, and F. C. Smith. In addition, Vice-Chairman R. S. Armstrong, Secretary A. Hurtgen, and J. S. Pettibone from ASTM Headquarters, were present.

NEW YORK

"DEVELOPMENT of the Technical Man and the Professional Attitude" suffered rather heavily at the hands of "Hurricane Hazel." The topic of the New York District meeting on October 15 which was cosponsored by the Metropolitan Section, American Society of Mechanical Engineers and the New York Chapter, New York State Society of Professional Engineers, roused considerable interest as evidenced from the extensive discussion period which followed even though the storm kept the audience relatively small.

William H. Larkin, now associated with the Air Preheater Corp. and a past-president of the NYSSPE, discussed "The Responsibility of the Engineer to His Profession," pointing out that all engineers should recognize the importance of developing his professional status and the need for taking an active part in engineering and technical societies.

Speaking on the subject, "The Professional Development of Technical Men," R. J. S. Pigott, Consulting Engineer and a past-president of ASME, emphasized the manner in which education, training, and practical experience can affect the engineer's professional attitude and his place in society. The nature of these two talks are of such general interest to our members that they are published substantially as given on pages 40 and 42 of this BULLETIN.

The program was arranged by W. T. Gunn, ASTM, who acted as chairman of the Program Committee; R. W. Cockrell, ASME; and H. C. R. Carlson, NYSSPE.

Jerome Strauss of the Vanadium Corp. of America, acted as Technical Chairman for the evening.

Prior to the technical session, ASTM Executive Secretary R. J. Painter and A. A. Berk, Chief, Industrial Water Branch, Region 8, Bureau of Mines, U. S. Department of the Interior, and present chairman of the Max Hecht Award Committee, made the first Max Hecht Award to Max Hecht, long-time chairman of ASTM Committee D-19 on Industrial Water. Earlier in the evening L. D. Betz arranged for a dinner in Mr. Hecht's honor at the Chemists Club. The citation reads as follows:

CITATION

The MAX HECHT AWARD has been established by ASTM Committee D-19 so that each year the outstanding cumulative contributions made by one of its members to the work of the committee and the industrial use of water may be recognized. The name of the Award honors the man who has served as Chairman of the Committee since its organization in 1932 and has concerned himself intensely with its activities for more than 20 years.

The Committee on Awards finds that no member has worked more notably, more diligently, or more effectively for the welfare of Committee D-19 than its chairman. His profound technical knowledge and his understanding of technical men have been responsible in large measure for the many achievements of this committee and the authority it has gained in the field of water as an engineering material.

By his inspiring counsel and leadership in power chemistry discussion and research groups, his stimulation of technical papers and programs, and his steady pressure and urging to produce needed test methods, Max Hecht has contributed immeasurably to better utilization of water by industry.

Max Hecht is the unanimous choice of his colleagues to receive the first MAX HECHT AWARD.

Conference on High-Frequency Measurements

THE fourth meeting of the Conference on High-Frequency Measurements will be held on January 17, 18, and 19, 1955, in Washington, D. C. Headquarters for the conference is the Hotel Statler and the sessions are to be held in the Department of Interior Auditorium. This meeting, which has become a biennial affair, presents the latest advances in the art of radio measurements. The 1955 meeting will be sponsored by Institute of Radio Engineers, American Institute of Electrical Engineers and URSI, and the National Bureau of Standards.

Topics of the four technical sessions are: (1) Measurement of Transmission and Reception, (2) Measurement of Power and Attenuation, (3) Measurement of Impedance, and (4) Measurement of Frequency and Time.

The ASTM in Paris

By Thomas H. Briggs

On June 24–26 a conference was held in Paris commemorating the 50th anniversary of the oxide cathode. The sponsoring organization was the "Société Française des Ingenieurs Techniciens du Vide." Representatives from about ten countries presented 68 technical papers describing recent advances which are helping to explain the art of Wehnelt's discovery and its changing into a science.

It was my privilege to deliver official greetings from the ASTM and to explain the organization and progress of the Society's Subcommittee on Oxide Cathodes of ASTM Committee B-4 on Metals for Electrical Heating, Electrical Resistance, and Electronic Applications. So unique is this type of industrial organization that this paper was accorded the honor of presentation at the formal opening session following the speech of welcome from M. R. Warnecke, president of the French Society.

At the conference, and in subsequent visits to many tube plants and laboratories, it was stimulating to learn of the esteem in which ASTM work is held. In particular, proceedings of Subcommittee VIII are followed closely. The published specifications and test methods are being used effectively.

A paper presented at the conference (Mullard's Ltd., United Kingdom) suggested improvements on a method for determination of sulfur in nickel, which had recently been published by ASTM. In France (La Radiotechnique) and in Holland (N. V. Philips), practical and theoretical work had been done with the committee's sublimation test, which will be of significance. In Germany (Valvo AG), the standard diode procedure is being employed for cathode and materials evaluation. Several other organizations are planning to modify their testing methods to make use of ASTM publications.

There was frequent expression of the need for coordination in engineering work so the results could be intercompared and could have common meaning.

In the field of emission spectroscopy there was a general desire to learn more of the newly standardized ASTM methods. Details of techniques employed were requested. The samples of nickel oxide powders for spectrograph calibration, which are just being standardized by this Society and the National Bureau of Standards, will fulfill a long-time need abroad as they will at home.

As a result of meetings and visits such as those just completed, one returns with a feeling that the deliberations, often lengthy, required to achieve a new ASTM Standard are well worth the effort. One knows that problems appearing of local or passing interest are those of other countries, too and that benefits are more far reaching than we can know—when we are too close to the trees to see the forest. It is also recognized how fortunate we are to have a Society with its background and scope which makes possible the interchange of knowledge and arrival at workable standards.

Encouragement of cooperation in the fields of technical standards beyond national boundaries is one of the best ways toward achievement of international understanding.

Sixth Pittsburgh Conference

The Sixth Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy will be held at the William Penn Hotel, February 28 through March 4, 1955. The Analytical Chemistry Group of the Pittsburgh Section of the American Chemical Society and the Spectroscopy Society of Pittsburgh will serve again as co-hosts. The Exposition of Modern Laboratory Equipment, held in conjunction with the Conference, may be expanded again. This is the largest exhibit of instruments, apparatus, and equipment exclusively designed to serve the analytical chemist, the spectroscopist, and the diffractionist.

ACI Adopts Standards for Proportioning Concrete—ASTM Methods Incorporated by Reference

After several years of study by its Committee 613, the American Concrete Institute has adopted Recommended Practices for Selecting Proportions for Concrete (ACI 613–54) which supersedes Recommended Practice for the Design of Concrete Mixes (ACI 613–44) adopted in 1944. Thirty-nine ASTM test methods are included by reference. Other test methods included by reference are three of the American Association of State Highway Officials, two of the Bureau of Reclamation Concrete Manual, and one of the Corps of Engineers Handbook for Concrete and Cement.

A second standard adopted by the ACI in 1954 is a Specification for the Design and Construction of Reinforced Concrete Chimneys (ACI 505–54). Both of the standards are published in the September, 1954, issue of the *Journal* of the American Concrete Institute.

The Light that Didn't Fail

Through the long night of October 19, 1879, Edison and his six research workers sat anxiously watching the brilliant glare of the world's first practical incandescent lamp. With this event, the 75th anniversary of which is celebrated this year, Edison gave universal application to the use of electricity as an industrial and domestic convenience.

Edison's work was the climax of years of frustration and failure by a host of earlier research workers who gradually developed the essential features of the lamp.

The honors for the first incandescent lamp go to Sir William R. Grove, an English judge and scientist, who in 1840 attached the ends of a coil of platinum wire to copper wires connected to a powerful battery. A glass flask enclosed the platinum wire whose open end was immersed in water. Grove lighted the auditorium of the Royal Institution with several of these lamps to illustrate one of his lectures, but the feeble light and large batteries required, made operation impractical.

The first patent for an incandescent lamp was issued to Frederick De Moleyns in 1841, in England. De Moleyns' lamp had two coils of platinum wire, containing charcoal powder, in a glass globe from which as much air had been removed as possible. This lamp, however, blackened quickly and it too was impractical.

J. W. Starr of Cincinnati, Ohio, also obtained a patent for an incandescent lamp in England, in 1845. His lamp contained a small carbon rod as the light-emitting element. The rod was enclosed in a glass tube, one end of which was attached to a platinum wire sealed through the tube, the other to a copper wire passing out through a mercury bath at the base of the tube. Several of these lamps were put on exhibition in London but these too blackened rapidly.

In 1878, Edison and his co-workers had begun an investigation of some 1600 minerals and plant fibers for use as filaments which might possibly bring success. Using his thorough, methodical approach, later known as "Edisonian research," he gradually reached a practical solution of the filament problem. Carbonized cotton thread, taken, according to legend, from his wife's sewing basket, had proved to be the answer.

On New Year's Eve, 1879, nearly 3000 persons stood in the streets of Menlo Park, N. J., to witness the first public demonstration of an Edison incandescent street lamp system. In the wintry evening 60 electric lamps lighted the snow-covered streets to the awe of thousands who came nightly thereafter to see for themselves the "Edison lights." Shortly following this demonstration a group representing the New York Board of Aldermen made an agreement whereby Edison would install a trial lighting system on Lower Manhattan.

In order to accomplish this, the Edison Illuminating Co. of New York was formed. Installation, however, proved to be an enormous task, as the whole concept of the central power station and its component parts had to be conceived, designed, and constructed.

The lamp of 1879 underwent continuous improvement: Japanese bamboo replaced the cotton thread as the carbonized filament. In 1893 cotton processed into cellulose filaments was introduced, and after the turn of the century a method for metallizing carbon filaments was developed. By 1911, the years of research spent on producing ductile tungsten resulted in the adoption of drawn tungsten filaments, and in 1913 the use of inert gas to replace the vacuum, greatly increased the efficiency of the incandescent lamp.

Mass production meant rigid control of machines and materials. Rigid control meant standard tests and specifications. Edison recognizing the increasingly important role of standardization in industry, was from 1916 until his death in 1931, a member of ASTM. One of his close associates, Cloyd M. Chapman, joined the Society in 1908, was its President for the 1932–1933 term, and was outstanding for the tremendous amount of work which he accomplished in the Society.

Today there are literally thousands of specifications for lamp assemblies, machine parts, and transmission equipment sponsored by individual companies. The National Bureau of Fire Underwriters publishes the National Electrical Code; The National Bureau of Standards, the National Safety Codes; and the American Society for Testing Materials publishes specifications and test methods for electrical conductors, electrical insulation and insulators, electrical heating and resistance alloys, and rubber protective equipment for electrical workers.

Technical Committee Notes

Electrodeposited Metallic Coatings

Participation Invited in 1956 Symposium

COMMITTEE B-8, meeting at ASTM Headquarters in Philadelphia on September 22, 23, and 24 was excellently attended not only in the main meeting, but also in the subcommittee meetings.

Within Subcommittee I on Specifications, Papers, and Definitions, a task group has been appointed to study the definition and treatment of "significant surfaces" as the term applies to B-8 specifications. Tentative plans have been made for holding a two-session symposium during the 1956 Committee Week. The chairman of the Symposium Committee is W. L. Pinner, Houdaille-Hershey Corp., 9120 Roselawn Ave., Detroit 4, Mich. The symposium committee would welcome suggestions or possible contributions for papers to be included in this symposium. A new task group has been appointed to consider the desirability of specifications for coatings other than decorative. Another task group is investigating the desirability of preparing specifications for the materials used in the plating industry. This would include such items as anodes, plating salts, etc.

Subcommittee II on Performance Tests is continuing its program of determining the effects of various atmospheric environments on copper-nickel-chromium-plated steel panels as well as lead-plated steel panels. A detailed report of the results to date will appear as a part of the 1955 report of B-8. Six types of chromate coatings on cadmium are also being studied in four types of environments, two indoor and two outdoor. The indoor exposures are of two types, one wherein the exposures are kept in a box similar to that which would be used for shipping purposes, and the other in which the specimens are mounted on a rack. The outdoor exposures are at New York City and Kure Beach. In the matter of weight loss of lead on the lead-plated panels referred to previously, the committee has decided to determine the individual weight loss on the separate sides of the panel, that is the upper and lower surface. Previously, weight loss was determined as total weight loss of the panel.

The section on tin and tin alloys has prepared its program of work and will consider first the effect of aging on solderability and will follow this with the development of a method of testing solderability. These early investigations will concern only essentially pure tin coatings, but later may include the tin-lead and tin-zinc coatings.

Subcommittee III on Conformance Tests is continuing its studies of indentation methods for hardness and ductility tests. A new section F has been organized which will concern itself with the measurement of stress in electrodeposited coatings. A temporary task group has been set up to investigate the suitability of studying the effect of temperature upon plated coatings.

Activity still runs high in the Subcommittee on Electroplating practice, and although the section on plating on malleable and cast iron has been handicapped by the death of one of its members, the section on plating on lead and lead alloys is making progress. The section on cleaning of materials prior to electroplating hopes to have a draft ready for the approval of the committee at the time of the next meeting in January.

Committee B-8, cognizant of its responsibilities in the field of metallic coatings, will recommend to the Board of Directors that the scope of the committee be revised to include coatings applied by chemical reduction methods.

Cement

Productive Meeting Held in Mississippi

SLAG cement may now be covered by an ASTM specification as a result of action taken at the meeting of Committee C-1 held at the Hotel Heidelberg, Jackson, Miss., on October 7 and 8. The meeting was held in conjunction with that of Committee C-9 on Concrete and Concrete Aggregates, through arrangements made by the Concrete Research Laboratory of the Corps of Engineers.

The new specification for slag cement is subject to letter ballot of the committee before presentation to the Society. It includes two types of slag cement: Type S for use as a blend with portland cement in making concrete and as a blend with hydrated lime in making masonry mortar; and Type SA, an air-entraining slag cement for the same uses as Type S. The proposed specification, as tentatively accepted, includes requirements for hydrated lime in accordance with the ASTM Specification for Hydrated Lime for Masonry Purposes (C 207) and the stipulation that the MgO content be limited to a maximum of 5 per cent.

Considerable discussion took place in subcommittee review of the proposal to increase the allowable MgO content in tentative specifications for Portland Blast-Furnace Slag Cement (C 205) from 5 to 15 per cent. No action was taken for the reason that insufficient data had been presented to assure that satisfactory concrete would result with this higher MgO content in respect to durability.

The question of the deletion of Type IV cement from ASTM specification C 150 received considerable attention arising from the fact that this type is now deleted from the Federal Specifications and that very little Type IV cement is now being manufactured.

The Sponsoring Committee on Portland Cement plans to hold a special interim meeting in the near future in order to crystallize the thinking and possibly be in a position to present recommendations to the committee at its next meeting. Revisions in the new Tentative Specification for Portland-Pozzolan Cement (C 340) were agreed upon, based on the need for provisions for adequate control of blending apparatus, as well as the deletion of the moisture content requirement.

Good response was reported on cooperative tests in comparing masonry cement strengths by three methods: these are hand mixing and mechanical mixing in accordance with ASTM Specification C 91 and a third method in accordance with Federal Specification SS-C-181b. These data will now be studied for further recommendation. Further data on water retention tests will be outlined at the next meeting of the committee.

Considerable progress has been made in a new field of activity, that of establishing criteria on false set. A draft of a proposed test method has been prepared for circulation to the committee before the next meeting. Refinements and qualifications in the test methods

for determining air content are being considered, and cooperative tests are being conducted to determine the effect of batch sizes on air content values. The results of an extensive series of tests among 22 laboratories for determining SO_3 content were reviewed and a summary of the data will be made available.

Carbon black as a grinding aid and color control in portland cement was considered for possible recognition as an acceptable material. No action was taken at this time, since only a small geographical area of the country makes use of this addition and in only limited amounts.

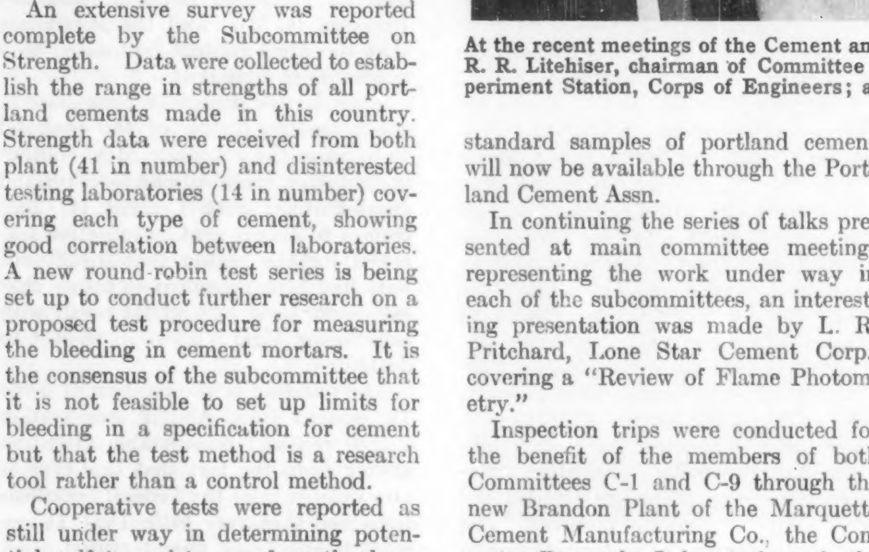
An extensive survey was reported complete by the Subcommittee on Strength. Data were collected to establish the range in strengths of all portland cements made in this country. Strength data were received from both plant (41 in number) and disinterested testing laboratories (14 in number) covering each type of cement, showing good correlation between laboratories. A new round-robin test series is being set up to conduct further research on a proposed test procedure for measuring the bleeding in cement mortars. It is the consensus of the subcommittee that it is not feasible to set up limits for bleeding in a specification for cement but that the test method is a research tool rather than a control method.

Cooperative tests were reported as still under way in determining potential sulfate resistance of portland cement. An important announcement was made with respect to chemical analysis of cement to the effect that standard samples of portland cement will now be available through the Portland Cement Assn.

At the recent meetings of the Cement and Concrete Committees held in Mississippi are R. R. Litehiser, chairman of Committee C-1; Col. C. G. Dunn, Chief, Waterways Experiment Station, Corps of Engineers; and W. H. Price, chairman of Committee C-9.

In continuing the series of talks presented at main committee meetings representing the work under way in each of the subcommittees, an interesting presentation was made by L. R. Pritchard, Lone Star Cement Corp., covering a "Review of Flame Photometry."

Inspection trips were conducted for the benefit of the members of both Committees C-1 and C-9 through the new Brandon Plant of the Marquette Cement Manufacturing Co., the Concrete Research Laboratories of the Corps of Engineers, and the Waterways Experiment Station sites, at both Vicksburg and Clinton, Miss.



During the C-1 and C-9 meetings, left to right: H. K. Cook, Master Builders; L. W. Teller, Bureau of Public Roads: L. E. Gregg, Kentucky State Highway Department; C. M. Weinheimer, Detroit Edison Co.; W. G. Shockley, Chief of Embankment and Foundation Branch, Waterways Experiment Station. Mr. Shockley is discussing uses of triaxial testing apparatus.

Concrete and Concrete Aggregates

Progress in New Fields Reported at Meeting

ENCOURAGING progress was reported in three new fields of activity by Committee C-9 at its meeting in Jackson, Miss., October 4 and 5. The meetings were held at the Hotel Heidelberg, in conjunction with the meeting of Committee C-1 on Cement.

In inaugurating the study of elastic and plastic properties of concrete, results of a questionnaire were discussed by the interested subcommittee and decision made to develop an extensive bibliography on the subject of creep, including a definition of this term. A literature review of pore characteristics of aggregates was discussed and various ways considered whereby pore characteristics affect aggregate performance. The third new field in which considerable progress has been made is in the preparation of a specification for packaged, dry premixed materials for mortars and concrete. The first draft of a specification was reviewed by the subcommittee, with the expectation that an acceptable draft will be developed for presentation at the next meeting of the committee. This proposed specification will include requirements pertaining to the manufacture, physical requirements, packaging, and test methods for both mortars and concrete mixtures.

Reports on additional subcommittee activities cover a wide range as noted in the following statements. Standardization of the definition and requirements of tamping rods, which are used in eleven different ASTM methods, is being developed. Prepared discussions on the subject of chemical reactions of

aggregates in concrete were presented, a written report of which will be distributed to the committee. The identification of deleterious substances in aggregates is continuing to receive attention, a method of test being considered which would provide a means of establishing generalized requirements of objectionable materials in specifications for concrete aggregate.

Sulfur capping received considerable attention in subcommittee discussion. Additional information is needed, particularly to determine bonding failure of caps. The need for further refinements in the requirements of the bearing blocks in the compression testing equipment was also discussed at some length. In the testing of fresh concrete, the Washington Meter apparatus is being considered for incorporation into the present pressure method for determining the amount of entrained air in hardened concrete. The Kelly Ball Penetration Method for measuring consistency of fresh concrete will be reconsidered for possible development into an ASTM standard. Limitations on the use of reactive aggregates are under consideration in a proposed revision to the Standard Specifications for Concrete Aggregates (C 33).

The addition of sections on marking and packaging to the three new specifications for lightweight aggregate (C 330, C 331, and C 332) received considerable discussion in the subcommittee but no agreement was reached at the time. In the field of admixtures, five groupings have been made for the guidance of the subcommittee: (1) pozzolanic materials; (2) finely divided particles; (3) air-entraining agents; (4) damp-proofing agents; and (5) chemical agents. A fifth cooperative series of tests has now been arranged for providing data for a method of test to measure resistance to abrasion of concrete. In a study of the determination of setting time of concrete, penetration tests, using the Proctor needle, are being made, and a bond pull-out test has shown possibilities. This test is used in walls and slabs, as well as in the laboratory.

A program of technical papers and talks was held during an evening session of the entire committee on October 5. Following a short address of welcome from Colonel C. H. Dunn, Director, Waterways Experiment Station, D. L. Bloem, National Ready-Mixed Concrete Assn., discussed "Studies of Uniformity of Compressive Strength Tests of Ready-Mixed Concrete." Hubert Woods, Portland Cement Assn., presented a paper entitled "Observations on the Resistance of Concrete to Freezing and Thawing," H. S. Meissner, U. S. Bureau of Reclamation, described a new method of measuring air voids in hardened concrete with the Bureau of Reclamation Vacometer. The session concluded with a color motion picture film entitled "The Inside Story of Concrete" which described the work at the Concrete Division of the Waterways Experiment Station. The committee participated with Committee C-1 in inspection trips as described in the account of the meeting of Committee C-1.

Thermal Insulating Materials

New Work Established on Reflective Insulation

Recognizing the importance of the field of reflective insulation, Committee C-16 has approved the organization of a new subcommittee to work on this type of material. A three-day meeting of the committee was held at Shawnee-on-Delaware, Pa., October 4–6. Reports were submitted by the several subcommittees indicating progress on the many projects under way.

Specifications for additional materials used in block and pipe insulation have been prepared. In this group is a proposed specification for cork thermal insulation for pipes which has received final approval in subcommittee and will be circulated for committee letter ballot. A specification for cellular glass pipe covering is in final stages of development.

The Subcommittee on Structural Insulating Board has reviewed revisions of the Specification for Structural Insulating Board Made from Vegetable Fibers (C 208) and the Methods of Testing Structural Insulating Board Made from Vegetable Fibers (C 209) for the purpose of including new requirements and methods for covering thickness, vapor transmission, inclined panel flame test, direct nail withdrawal, lateral nail resistance, moisture content, and density. Methods of tests covering uniform load, concentrated load, and impact load for testing insulated roof deck were proposed for ultimate submittal to ASTM Committee E-6 on Methods of Testing Building Constructions. The subcommittee will work on new classes of flame-resistant interior finish board, shingle backer, and possibly insulating roof deck. A definition of the term "Structural Insulating Board" will be prepared in both general as well as specific terms.

The Subcommittee on Loose-Fill Insulation confined its attention to a review of a proposed specification for determining the density at which loose-fill insulation should be applied. The Federal Housing Administration will be contacted in order to establish proper standards.

Final review was given to proposed tentative methods of tests for compressive hardness and for adhesion of thermal insulating cement by the responsible subcommittee. As a result of consideration of negative comments, the term "compressive hardness" was changed to "compressive strength." These two methods are now ready for presentation to the Society. Results of cooperative tests on a proposed wet adhesion test for thermal insulating cement were discussed, and it was concluded that more test data are required. Tests will also be made on a proposed method of measuring plasticity of thermal insulating cements.

The Subcommittee on Special Thermal Properties reported considerable discussion and action on revisions of a proposed test method to measure linear shrinkage. This method is now ready for acceptance by the committee. A maximum use-temperature test method also received final review and was recommended for committee letter ballot, following review by the Editorial Subcommittee. A method for determining hot surface performance will be resubmitted to the subcommittee for further action. The development of an emissivity test procedure has not yet been completed and the task group considering this method has been reconstituted.

The Subcommittee on Dimensional Standards has reviewed a proposed sampling plan requested from Committee E-11 on Quality Control. Agreement could not be reached, however, on a satisfactory "risk factor," and it was recognized that a lack of understanding of the statistical approach is handicapping the subcommittee. A revised draft of a proposed method of sampling preformed thermal insulation will be prepared and submitted to the subcommittee members.

Final consideration was given to a proposed method of test for water-vapor transmission of materials used in building construction. Consideration was given to comments from negative votes and the proposed method will be submitted to the Society for acceptance.

A detailed report was presented on the research program being conducted at Pennsylvania State University on Effect of Moisture on Thermal Conductivity of Insulation. The two objectives in this program were outlined as being, first, to find a satisfactory technique and, second, to measure k-values of wet insulations. Work to date has been directed to the first objective. A probe has been developed which has proved very satisfactory in conducting this investigation. It is expected that further funds needed for the completion of the project will be solicited in the near future.

Structural Sandwich Construction

Expansion of Sandwich Structures in Building Field Stressed

THE expansion of usage of sandwich construction in the building field was stressed at the fall meeting of Committee C-19 on Structural Sandwich Constructions. The committee met at the Purdue Memorial Union, West Lafayette, Ind., on October 19 and 20.

There is definite need for basic definitions of terms regarding sandwich construction, and the responsible subcommittee will give this consideration. Additional test methods for basic sandwich components are receiving attention, including a compression test of sandwich cores, a core delamination test, and a core thickness test.

In the consideration of the test methods for sandwich construction, a proposed edgewise compression test was discussed, particularly with respect to the effect of the length of specimen. This method will be resubmitted for subcommittee letter ballot. A proposed flatwise flexure test method will also be resubmitted for subcommittee letter ballot. Opinions will be obtained from subcommittee members on a comparison of a drum test and the Martin test in measuring peel.

A well-attended dinner meeting was held at the Purdue Union Club, at which two papers were presented: "Sandwich Construction in the Building Industry," by Walter Lovett, Pittsburgh Corning Corp.; and "Aircomb Panels in Building Construction," by Steve Yurenka of Douglas Aircraft Co. Following the meetings the committee toured the National Homes Corp. plant to observe production of prefabricated houses.

Porcelain Enamel

Fall Meeting Held at New Westinghouse Plant in Columbus

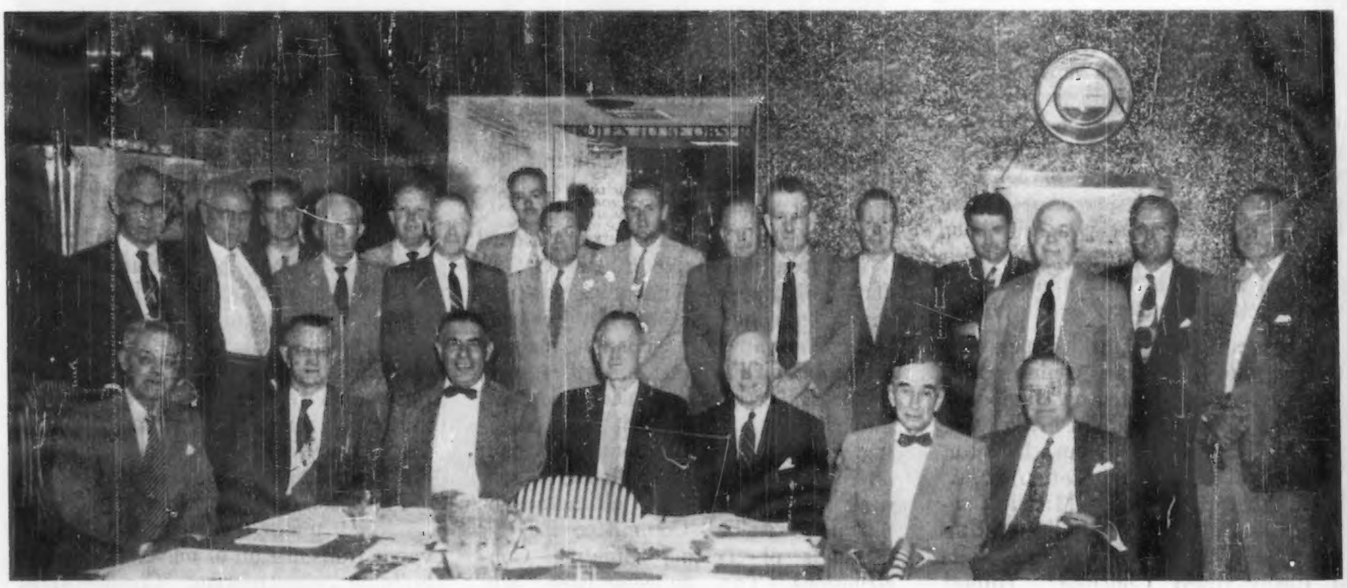
THE fall meeting of Committee C-22 was held at the new Westinghouse plant in Columbus, Ohio, on October 19 and 20. A limited tour of the plant, which represents the very latest in modern production methods, followed the main meeting of the committee.

A full program of subcommittee meetings was held, starting with the Subcommittee on Nomenclature, which is continuing a detailed review of an extensive glossary of terms proposed for publication. The Subcommittee on Education plans further publicity among the various schools of the country.

The Subcommittee on Raw Materials and Materials in Process reported it has ten projects in varying stages of development. A proposed method for measuring reflectivity and coefficient of scatter has been completed. The proposed methods nearing completion include an analysis of water for mill additions, a torsion test, a fusibility test, and an evaluation of set characteristics of clays.

The Subcommittee on Products also reported on ten projects. Procedures for measuring gloss, abrasion, thickness, thermal shock, and continuity of coating are in varying stages of completion. A method of test on chemical ware will be limited to the development of an alkali test. Other proposed procedures include scratch and metal marking. The work on impact has been completed. The consideration of color and color difference is being held in abeyance at the present, pending research being conducted at the National Bureau of Standards and by the Procelain Enamel Inst.

The Subcommittee on Research has under consideration short and long-term effects of porcelain enamel coatings on high- and low-alloy steels; thermal expansion tests; a study of interferometer and dilatometer methods; fish scaling; emissivity; and reflectivity. The evaluation of enamel iron, particularly in reference to sagging, has been completed and the information referred to the Subcommittee on Raw Materials and Materials in Process.



Pictured at the meeting of Committee C-13 are, front row, left to right: F. C. Ziegler, M. G. Spangler, E. F. Bespalow, R. R. Litehiser, H. F. Peckworth, E. F. Kelley, J. A. Dunn. Back row, left to right: H. G. Curtis, R. W. Gilmore, J. B. Verhoek, W. L. McDaniel, J. G. Parlett, M. Butler, F. B. Brown, H. W. Heath, H. W. Easterly, Jr., C. M. Howard, M. W. Loving, B. J. Bullwinkle, J. H. Bailey, W. E. Corbett, P. Van Kuran, and L. C. Gilbert.

Bibliographies have been completed on spontaneous chipping and spalling, and on fusibility. This information has referred to the proper subcommittee for further consideration of proposed standards.

Petroleum Products and Lubricants

D-2 Participates in Symposium on Liquefied Petroleum Gases

175 engineers from all parts of the United States and from Canada participated in a Symposium on Methods for Testing Liquefied Petroleum Gases in St. Louis on September 27 and 28 under the joint auspices of ASTM Committee D-2 on Petroleum Products and Lubricants, ASTM Committee D-3 on Gaseous Fuels, the Natural Gasoline Assn. of America, and the California Natural Gasoline Assn.

The success of the extensive symposium was largely due to the efforts of Chairman B. J. Heinrich, Phillips Petroleum Co., and to the members of his various committees. The local Committee on Arrangements consisting of W. K. Oliver, chairman, Socony-Vacuum Oil Co., J. K. Dixon, Shell Oil Co., and A. B. Wilder, E. I. du Pont de Nemours & Co., Inc., assisted greatly in conducting the meeting and in handling the many necessary details.

In his keynote address, "LP-Gas Looks Forward," R. C. Alden pointed out that the marketed production of LPF now exceeds in volume the demand for kerosine and is considerably ahead of the demand for lubricating oil in the USA and that LPG is displacing kerosine as the fourth largest liquid petroleum product. The following were singled out as indications of continued rapid growth for the LPG industry: accelerated trend toward suburban homes, use as automotive fuel, use as chemical raw material, development of underground storage, pipeline transportation, and increase in reserves of natural gas liquids which are increasing faster than crude oil or natural gas reserves. The total LP-gas liquefied and used as fuel contributes almost as much to the U. S. energy supply as does water power.

The use of liquefied petroleum gas as a fuel for internal combustion engines has been continually increasing during the past years, and sales for motor fuel reached an all-time-high of about 500,000,000 gal in 1953. This interest in LP-Gas is caused by a favorable price structure in comparison with other fuels, longer engine life, less maintenance and oil consumption, lower fuel cost, clean and odorless engine operation and other reasons. Liquefied petroleum gas is used for other purposes, especially for industrial and household heating.

As a result of this increasing use of LP-Gas, the four organizations sponsoring this symposium realized that the development of methods of test could no longer be handled satisfactorily by the somewhat informal means which were quite effective a decade ago. One of the main purposes of this symposium was to review the numerous methods that are now being used in the testing of LP-Gases and to further the development and improvement of such methods through the cooperation of the producers, consumers, and others having a general interest in such materials. The titles and authors of the 35 papers were announced in the July issue of the ASTM BULLETIN.

Technical High Lights

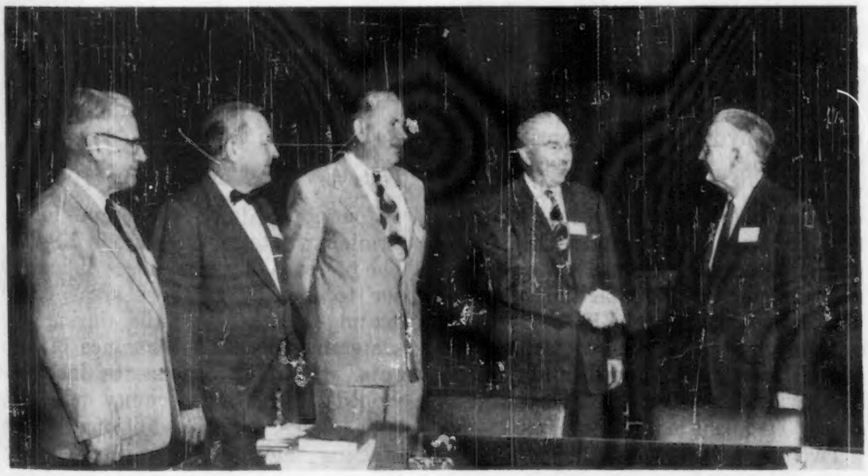
Some of the highlights of the information contained in the 35 papers are summarized below.

LPG is defined as follows in the California Natural Gasoline Assn. *Bulletin TS-441:* "Liquefied petroleum gases are gaseous hydrocarbons held in the liquid state by the maintenance of the necessary pressure. These hydrocarbons are principally propane, isobutane, and normal butane in widely varying proportions. The olefin hydrocarbons, propylene, isobutylene, and the two butylenes are sometimes present in liquefied petroleum gas mixtures in small proportions. The proportions of the various hydrocarbons in a liquefied petroleum gas mixture determine its physical characteristics."

A summary of the procedures currently used in the United Kingdom in the testing of LP gases and similar hydrocarbon gases was presented by the Petroleum Gases Panel of the Institute of Petroleum (London). This was of particular interest because it is hoped that after LPG methods become established as American standards they will then be considered for international acceptance.

LPG in Passenger Buses:

Considerable interest was evidenced in the paper describing the use of testing methods for LPG by the Chicago Transit Authority. There are in use in Chicago over 500 passenger buses in which the fuel used is essentially commercial propane as specified in NGAA Standard 2140. Current annual consumption is about 12,000,000 gal. The fuel is tested regularly each month at each of four garages by an independent commercial testing laboratory. The laboratory personnel take the samples and make all the tests presenting a written report within four days to the Chicago Transit Authority. This enables the CTA to take appropriate action. The following tests are made on each sample to determine compliance with CTA specifications: (1) composition of product, (2) residue contaminants, (3) vapor pressure, (4) sulfur content, (5)



Officers of Committee C-22 on Porcelain Enamel at their recent meeting. Left to right: Dwight G. Bennett, 1st vice-chairman; G. H. Spencer-Strong, secretary; S. E. Sites; R. F. Bisbee, 2nd vice-chairman; W. N. Harrison, chairman.

Authors of papers presented at the first day's sessions of the LPG Symposium are, left to right: W. H. Alderson, C. M. Heinen, L. T. Bissey, A. P. Gifford, B. J. Heinrich, symposium chairman, W. J. Podbielniak, H. A. Price, R. F. Robey, J. B. Gregory, L. V. Sorg, W. A. Patterson, V. H. Gunther, D. M. Mason, J. E. Walker, H. Eby, R. C. Alden, and J. F. Hickerson.

water content, (6) nonvolatile matter, and (7) corrosion by bomb method.

Infrared and Mass Spectrometer Methods:

The use of infrared techniques and mass spectrometry for the analysis of LPG were covered in two papers. The infrared spectrophotometer is one of the newer analytical instruments and frequently is sufficient for most problems. However, the urgency and complexity of modern chemistry often require the application of other instruments such as the mass spectrometer. The papers pointed out the way these two instruments have been applied on certain problems in the field of LPG. Another interesting paper described the low-temperature fractional distillation analysis method for determining individual components of gaseous and volatile hydrocarbons and other mixtures.

With the rapid growth of the LPG industry there has developed a need for rapid process methods for gas analysis. Of interest in this connection were two papers, one of which described the analysis of LPG fractional adsorption and the other the application of infrared methods to light hydrocarbon gas analysis.

Tests for Sulfur:

The presence of sulfur in LPG, whether in the form of free sulfur, elemental sulfur, or hydrogen sulfide, presents an important problem in the industry because of the ease with which it is formed and due to its corrosive nature. Accordingly there was a series of nine papers devoted to various methods for determining sulfur in its several forms when present in LPG.

An instrument for measuring and recording hydrogen sulfide in air and other gases in the concentration range from 0 to 100 ppm was described. Since hydrogen sulfide is a deadly poison, it causes concern as it is always [illegible]t in petroleum refining operatio[illegible] concentrations over 20 ppm it i[illegible]dered unsafe.

The use of the polarograph for determining elemental sulfur in LPG in concentrations as low as 0.01 ppm was described in another paper. A rapid method for determination of free sulfur in LPG by ultraviolet was also described. This method requires only about 20 min to determine free sulfur in LPG in the range from 0 to 20 ppm.

One of the increasing uses of LPG is for household heating, and many states require all domestic fuel gas to contain a minimum amount of some odorant. Measured amounts of mercaptan sulfide are used for this purpose. In order to control the final concentration of the odorant, methods of analysis are required. There were two papers which described procedures for the determination of the total mercaptan sulfur content of LPG. One of these was a simplified amperometric method in which the LPG sample is bubbled through a solution of acid cadmium sulfate to remove any hydrogen sulfide present and then through an excess of silver nitrate to absorb the mercaptan as sulfur mercaptides. The existing nitrate is then titrated amperometrically. The other paper described the use of a mass spectrometer for determination of individual mercaptans in LPG. By this method individual mercaptan compounds can be determined in about $1\frac{1}{2}$ hours within an accuracy of ± 1 per cent on a 100 per cent mercaptan basis.

Two methods for determining hydrogen sulfide and free sulfur in LPG were described. One of the methods was a quantitative procedure suitable for experimental and developmental work. The other method was especially applicable to the semiquantitative detection of relatively small concentrations, and was designed to be used for production control purposes. Another paper described the operation of an automatic and continuously recording titrater, commercially known as Titrilog, and its application in the LP-gas industry. A method for determining total volatile sulfur in LPG was also described.

The copper strip test for detecting the presence of corrosive sulfur in hydrocarbons has long been in use in the petroleum industry. Under sponsorship of the NGAA a research study of this method as applied to LPG was accordingly undertaken at the University of Texas in 1949. A very interesting paper described the results of this study. Investigation was made of the effect of hydrogen sulfide, sulfur, and methyl mercaptan in propane and butane in the stenched and unstenched condition, both wet and dry. These variables were evaluated by several different test systems. The paper reviewed the theoretical basis of the copper strip test and presented general observations on the basis of these studies.

Tests for Water and Moisture:

Four papers described methods for determining water or moisture in LP-Gas. The presence of water causes difficulties due to freezing in those areas where freezing weather prevails during the winter months. The entrance of rain water, snow, or condensate into uncapped loading hoses, empty cylinders, sludge tanks, etc., are additional factors affecting moisture conditions. Four different dew point methods for determining moisture and LPG were described. Another paper dealt with a

Authors of papers presented at the second day's sessions of the LPG Symposium are, left to right: D. A. Schock, W. R. Dietz, — Webber, R. O. Clark, Chairman B. J. Heinrich, V. R. Ratzlow, L. Andrews, W. A. Hartmann, R. E. Hyzer, J. E. Walker, V. H. Gunther, L. V. Guild, P. A. Wilks, Jr., J. W. Martin, C. W. Ricker, G. L. Wherry, N. W. Hartz, S. Schuhmann, and W. H. Alderson.

procedure for determination of water in LPG by acetyl chloride based upon the fact that pyridine acetyl chloride reagent reacts with the water to produce two moles of titratable acid, while it reacts with alcohol to yield only one mole of acid. By reacting the sample and a blank with this reagent and then decomposing the unreacted portion of the reagent with anhydrous ethyl alcohol, the concentration of the water in the sample can be computed from the difference in titratable acidity. In all cases where the method was applied to plant samples, consistent and plausible results were obtained.

The cobalt bromide test for determining water was also described and a companion paper presented studies of factors affecting the cobalt bromide test for water in propane.

A method for determination of trace amounts of carbonyl sulfide in hydrocarbon gases was described based on the reaction with piperidine in alcoholic solution to form piperidine oxythiocarbamate which is determined spectrophotometrically. The method is directly applicable to gases containing hydrogen sulfide, sulfur dioxide, and aromatic hydrocarbons not exceeding the equivalent of 50 ppm of benzene; higher concentrations of aromatics can be tolerated provided they are known or can be determined. Data on synthetic blends indicate that the results within the range of 2 to 75 ppm of carbonyl sulfide are reliable to within 5 per cent of the amount of sulfide present.

Safety Measures and Miscellaneous Tests:

The importance of taking safety precaution measures in the field in the transportation of LPG was illustrated by one of the authors with a series of colored slides. The importance of taking safety precautions in the obtaining of samples of LPG for testing was also discussed.

The presence of oxygen in gaseous hydrocarbons used as feed stocks to certain catalytic reactions is frequently a source of trouble. In some reactions only a few parts per million of oxygen can be tolerated. Determination of oxygen accordingly becomes an important adjunct to plant control. In this connection there was described a simplified procedure for estimating oxygen in hydrocarbon gases which uses a portable apparatus and is intended only for semiquantitative estimation of oxygen content under field conditions.

The specific gravity of commercial propane is quite important in the distribution sale of this LPG product. The Government regulations covering the filling of LPG containers is expressed in terms of the specific gravity of the stock and the water capacity of the cylinder. In this connection there was presented a very interesting paper describing a method for calculating the specific gravity of commercial propane from its vapor pressure and olefin content. An improved hydrometer for determining the specific gravity of LPG products was also described. This instrument is a combined hydrometer-thermometer. It contains an ordinary mercury thermometer placed inside the hydrometer so that the thermometer bulb is coincident with the lower tip of the hydrometer and exposed to the liquid whose gravity is being measured. This type of hydrometer eliminates one of the errors due to compression of the bulb resulting from the liquid when it is tested under pressure. There was also described a pycnometer method for determining specific gravity of LPG. This method is more accurate than the hydrometer procedure and does not have the safety hazards which accompany the present pressure pycnometer. The method described requires a torsion balance to 0.1 g and a suitable thermometer for satisfactory results.

The two concluding papers in the symposium described a method for determining small quantities of air in the vapor phase of cylinders containing LPG, and equipment for detecting light hydrocarbons in cooling water.

Shipping Containers

Report on Joint Testing Activities

The joint activities of Subcommittees II on Methods of Testing, IV on Performance Standards, and V on Correlation of Tests and Test Results, which have been channeled into four task groups, were reported at the meeting of Committee D-10 in Chicago, Ill., September 30 and October 1.

The Task Group on Drum Testing has collected a great amount of information concerning the variation in location and size of baffles in the existing drum tumbler testers in an effort to explain poor correlation of interlaboratory cooperative tests. This group intends, upon completion of its work, to make recommendations for uniform construction of drum testers. The Task Group on Vibration Tests has a similar program concerned with the variations in machines for the vibration testing of shipping containers. At present this group is assembling the results of an interlaboratory cooperative series of tests designed to show the differences between vibration testing machines of various laboratories.

The Stacking Test Task Group is in the midst of an interlaboratory series of tests designed to determine the best requirements for a stacking test method.

The Task Group on Drop Test is making a comparative study of dropping containers from varying heights, on several types of surfaces, and with varying loads.

A proposed method of testing the load-displacement characteristic and drift and permanent set of package cushioning materials was reviewed and will be presented for subcommittee ballot. A list of other tests for inclusion in an over-all method of testing interior packing was presented to outline future activities of the group.

Statistical Methods Course

THE Institute of Statistics at North Carolina State College is sponsoring a nine-day intensive training program in Statistical Methods for Research Workers in Industry and the Physical Sciences starting January 22 1955 and running daily (including Sundays) through January 30, 1955. The course is designed to make available to research workers in industry and the physical sciences the new and powerful statistical techniques of data analysis and experimental design. Guest lecturers will include W. J. Youden, Statistical Engineering Laboratory, National Bureau of Standards; Carl A. Bennett, Hanford Works, General Electric Company; and Cuthbert Daniel, Statistical Consultant, New York City.

Textile Materials

Meetings Expand to Four-Day Session

COMMITTEE D-13 on Textile Materials held a four-day meeting in Washington, D. C., on October 19–22. The work of the committee has expanded to such an extent that it is now necessary to devote an extra day to the meetings in order to provide time for working groups on specific assignments. There were meetings of about 14 such groups on the first day. These were followed by meetings of 20 subcommittees and sections during the remainder of the week.

A highlight of the meeting was a dinner on Thursday evening, October 21, at which the guest speaker was the Honorable Walter Williams, Undersecretary of the Department of Commerce. There were over 200 members and guests present during the four days of technical sessions, during which actions were taken on several new test procedures and revisions completed in a number of others.

The committee has had under consideration a reorganization of its subcommittee structure. After careful review and discussion, it was decided to establish individual subcommittees on specific materials and subjects. These will be further divided into groups with specific assignments. This type of organization should simplify the activities of the committee and will replace the present organization which is made up of subcommittees, sections, task groups, etc. The proposed reorganization will now be submitted to the entire committee for approval before being put into effect.

The Section on Cotton recommended that the Test for Length by Fiber Array be adopted as standard and published under its own ASTM designation, thus removing it from the general Methods D 414. It is also recommended that the test for neppiness now appearing in Methods D 414 be discontinued. This procedure is no longer necessary since there is available the Tentative Method of Test for Number of Neps in Cotton Fibers (D 1446). The Test for Immaturity by Polarized Light is being rewritten and will be completed by the March meeting for publication as a separate tentative. With these changes all of the detailed procedures will have been removed from Methods D 414, and this designation will accordingly be discontinued.

A new length method for cotton which will be an alternate procedure to the Test for Length by Fiber Array is now undergoing an interlaboratory test program in nine laboratories using three arrays on five cottons. It is hoped that this program can be completed and action taken on the new method by the next meeting in March. Consideration is being given to the desirability of preparing an operators' manual for use in the laboratory which would include detailed information on apparatus and testing technique to supplement that given in the standard methods.

The Section on Woolen and Worsted Fabrics has completed a Proposed Method of Test for Reference Weight of Wool or Part Wool Fabrics. At its meeting it also received a report on results obtained on studies of the Celanese wrinkle recovery tester and the Monsanto crease recovery tester made on a range of fabrics. A report was also presented on the thickness measurement of woven textile fabrics. The present methods are in general considered inadequate and in need of revision.

The Subcommittee on Warp Knit Fabrics, which was established about a year ago, is making excellent progress. Reports were presented by groups working on the following subjects: (1) nomenclature and definitions, (2) dimensional changes (shrinkage) in laundering, (3) strength and related properties, (4) yield and related properties, and (5) grading.

The Section on Wool received progress reports on the following six projects: (1) test for wool content of raw wool (commercial and laboratory scale), (2) core sampling, (3) vegetable matter and alkali insoluble impurities in scoured wool, (4) fineness standards, mohair tops, (5) moisture testing, and (6) fiber length determination.

The Subcommittee on Ultimate Consumer Textile Products has had three active groups on (1) slide fasteners, (2) elastic fabrics, and (3) pilling tests. A series of definitions and nomenclature together with methods of testing slide fasteners are being completed, and it is now hoped that they might be ready within the year for subcommittee letter ballot. The first set of Methods for Testing Elastic Fabrics (D 1333 – 54 T) was issued this year. These include procedures for the ultimate elongation test, tension test, and set test. Further interlaboratory studies are under way, results of which will be considered at a meeting of the group to be held shortly in New York. The group on pilling tests reported that an extensive study had been made of methods for determination of pilling of fabrics. The interlaboratory results indicated that there is no real difference between the four test procedures. Since the four methods have been used quite generally by industry, it was decided to proceed with the preparation of proposed methods for subcommittee letter ballot which would include all four tests. Further experience with the methods after they have been published as tentative may indicate that one or more of the procedures is not necessary.

Other problems discussed by the subcommittee were (1) seam slippage, (2) water and solvent spotting, (3) fabric fraying, (4) needle cutting, (5) blistering of fused collars, and (6) tests for findings and buttons. It was decided to refer the problem of water and spotting solvent to the Joint ASTM-AATCC committee, since this appears to be closely related to the finishing of fabrics. It was decided to request the D-13 Advisory Committee to establish a subcommittee on seams, sewability, and related problems. There was considerable discussion concerning the button problem, which has many ramifications, including such things as melting, effect of solvents, efficiency of attachments, discoloration, etc. In view of the complexities of this problem, the matter will be considered further at the next meeting.

The Subcommittee on Pile Fabrics is recommending the adoption as standard of the Tentative Method of Test for Resistance of Pile Floor Coverings to Insect Pest Damage (D 1116 – 50 T) with certain revisions. Plans were reported on an interlaboratory test

program on the flammability test for pile floor coverings to be made on 14 test fabrics, covering a wide range of qualities, yarns, and fabrics, to be run by six laboratories. The group on test methods for tufted pile floor coverings has been especially active, and at its last meeting considered the following projects: (1) soiling test, (2) tuft bind test, (3) rubber backing test, (4) colorfastness tests, (5) glossary of terms and definitions. The group on service evaluation of carpets has in preparation an abrasion resistance test for all wool pile floor coverings and also plans to prepare similar test methods for other fabrics.

The meeting of Subcommittee B-1 on Test Methods is always one of the highlights of the D-13 meeting. A full morning was devoted to this meeting with an attendance of over 150. At the conclusion of the meeting there was presented a very interesting paper on Methods of Measuring the Lustre of Yarns, by Lyman Fourt, of Harris Research Laboratories.

Methods for determining fiber weight per unit length by means of the Vibroscope are being studied in a comparative test program in seven laboratories. These studies will include fibers of both low and high deniers and also those with both round and elongated cross-sections. Details of the test procedure to be followed in the comparative test are now being prepared. This will include the variable weight procedure and the test by variation of frequency.

Work is also being undertaken on the definition and measurement of fiber crimp. The group on stress-strain parameters recommended that the present committee be disbanded and in its place three new groups be established as follows: (1) group to obtain load-elongation curves for fibers of all types, (2) group to study load-elongation curves based on work of the first group, and (3) group to study parameters to use after group 2 is finished. The committee on evenness of yarns reported that it had prepared a draft of proposed Tentative Methods of Test for Determining Linear Unevenness in Yarns. These procedures are applicable to single strands of any type of yarn—single, plied, or folded yarns, cords (cabled yarns) and threads of any textile material. Linear unevenness, LUE, is calculated from data obtained by measurements of related yarn properties. There are three principal methods and type of equipment for supplying the data: (1) measurement of variations in yarn profile, (2) measurement of variations of contiguous, compressed, cross-sectional areas of the strand, and (3) measurement of the results of variation in yarn properties affecting a capacitance circuit. Since there are a number of different machines for determining evenness of yarns, it may be necessary to issue a supplement to the standard method that would contain detailed descriptions of the apparatus.

Considerable work is under way on the qualitative and quantitative analysis of textile fabrics. These studies are directed particularly toward the newer fibers; for example, procedures are being developed for determining dynel, acrilan, dacron, orlon, nylon, vicara, and viscose rayon in mixtures. The group on performance tests presented a summary of its projects on abrasion resistance, water resistance, flexibility test for fire resistance, thermal conductivity, and degree of mercerization. The Tentative Methods of Test for Abrasion Resistance of Textile Fabrics (D 1175 – 51 T) is being revised, making changes in two of the four test procedures covered. An abrasion test for yarns using the Stoll machine is also being prepared for submission to vote of the subcommittee.

The Subcommittee on Nomenclature and Definitions has in preparation an extensive list of fabric defect terminology.

Adhesives

Committee Considers New Methods and Specifications

The meeting of Committee D-14 on October 7 and 8 in Washington, D. C., was highlighted by a discussion of detailed investigations of wood cross-lap specimens for adhesive testing presented by Alan Marra. In this investigation the wood had varying areas of adhesive contact, at varying thicknesses of adhesive and was conditioned at various relative humidities. The results were most interesting and stimulated lengthy discussion.

Work during the past year has culminated in several specifications and methods which were presented for subcommittee review at the meeting. Among these were the specifications for adhesives for sealing top flaps of fiberboard shipping cartons. This specification is applicable to adhesives used in automatic case sealing equipment. A method for determining the effect of moisture and temperature on label to glass adhesive bonds was also presented. In this method the adhesive performance is expressed as a percentage of the amount of the paper remaining on the adhesive film.

The Proposed Method of Test for Susceptibility of Dry Adhesive Films to Attack by Roaches and the Proposed Method of Test for Susceptibility of Dry Adhesive Films to Attack by Laboratory Rats, which were published last June as information, are now being referred to the committee by letter ballot for acceptance as tentative.

Work undertaken by the subcommittees and not as yet ready for presentation covers methods for testing cleavage strength of adhesives, methods for determining critical glue-line thickness, and specifications for high- and intermediate-temperature setting adhesives. Investigative work under study includes study of new peel test assemblies, methods of measuring degree of adhesive penetration, reduction of the time necessary to test the effects of salt water on wood-to-wood adhesives, and a procedure for sampling adhesives in large shipments.

Engine Antifreezes

Glassware Corrosion Test Undergoes Revision

At the October 15 meeting of Committee D-15 held in New York City, the suggested procedure for the glassware corrosion test for engine antifreezes, which has entered its fourth revision following extensive interlaboratory collaborative testing, was reviewed. One of the drawbacks to this method has been the loss of volatile components of the antifreeze, particularly in the case of the low boiling alcohols, such as methanol. To prevent this, a modification was presented in which the reflux condenser was attached to a cooled Dewar flask acting as a cold trap. This arrangement considerably reduced the loss of methanol by condensing it in the trap and permitting the operator to return the methanol to the corrosion sample in the beaker.

The interlaboratory collaborative tests on rubber hose samples immersed in antifreezes are continuing with 30 beaker tests being run in twelve cooperating laboratories. The specimens used for this method are 1 by 2-in. strips from reclaim, neoprene, and butyl rubbers. The method directs that the specimen shall be cleaned and dried in a prescribed manner, and then the sample suspended in the antifreeze for 70 hr at a specified temperature. The report includes changes in appearance, hardness, volume, and weight.

ASTM Wood Pole Research Program

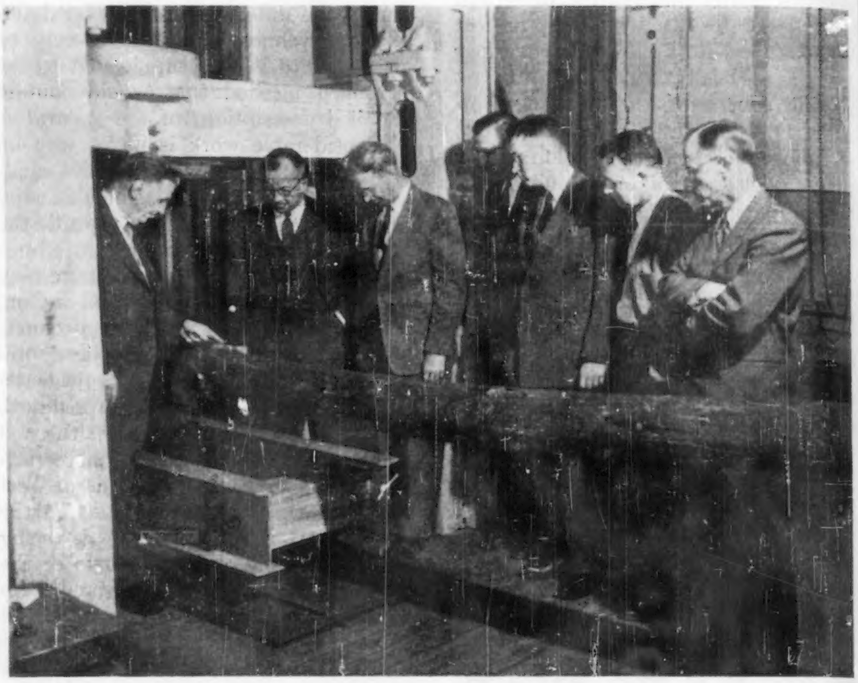
THE first progress report on the ASTM Wood Pole Research Program issued earlier this year and reported in the April, 1954, issue of the ASTM BULLETIN, announced the starting of the research work with the testing of the first western larch poles.

Substantial progress is being made in the conduct of the Research Program under the supervision of the Technical Advisory Task Group of the Subcommittee on Wood Poles and Cross Arms. This progress included completion of the tests of untreated western larch poles in cooperation with the Rocky Mountain Pole and Treating Assn. and work in summarizing the data; selection and testing of poles of four species of southern pine; testing of small clear specimens from the pole material; collection of untreated Douglas-fir poles in the Pacific Northwest; and the beginning of the analysis of the accumulating data. In addition, tests have been completed on the comparison of the machine-test method with the crib-test method, using full-size southern pine poles.

The first year's contributions received have passed the halfway mark on the $160,000 program. The committee is extending an invitation for second-year contributions from those already supporting the program, and is undertaking the further solicitation of funds to insure the completion of the entire program as planned, including tests of treated material.

Some 54 poles were included in the western larch tests—five 55-ft class 1 or 2 poles, six 25-ft class 9 poles, and forty-three 20-ft class 6 poles. Of the class 6 poles, 31 were selected to be of approximately average specific gravity for the species, with six poles of lower than average specific gravity. Thus, the tests will provide basic data on the strength of average poles, together with information on the effect of variation in density and size. Included also were tests on small clear specimens covering density, static bending, compression-parallel-to-grain, hardness, and toughness.

A preliminary analysis of the larch data shows that the average of the strength values in the basic group of 31 poles slightly exceeded the present ASA-assigned fiber-stress value for western larch. As was expected, the values



Cooperators in the ASTM pole research program examining a pole after failure in the machine test. Left to right: L. J. Markwardt, U. S. Forest Products Laboratory; G. Q. Lumsden, Bell Telephone Laboratories; H. W. Armfield and W. J. Hecker, Wisconsin Telephone Co.; D. E. Kennedy, Forest Products Laboratories of Canada; O. A. Hanna, Bell Telephone Laboratories; I. V. Anderson, U. S. Forest Utilization Service.

Pole research program personnel examining a southern pine pole after failure in the crib test. Left to right: L. J. Jacobi, L. J. Markwardt, R. P. A. Johnson, and L. W. Wood.

from poles of high and low density showed a correlation of strength with specific gravity, and the tests of extra large and extra small poles indicated the presence of a size factor. The results of tests of small clear specimens were being correlated with existing values from standard tests of western larch and with the strength values in the full-size poles. Stiffness of the poles as observed in tests was related to the modulus of elasticity of the small clear specimens. Further analysis on western larch will be made as data become available from the treated larch poles and poles of other species.

Untreated longleaf and slash pine poles were selected in the forest of the

lower coastal plain of southern South Carolina, shortleaf and loblolly pine from central Louisiana. Altogether 109 poles of the four species were collected, the longleaf and shortleaf including 25-, 30-, and 55-ft sizes, as for the larch, but only the basic 30-ft size in slash and loblolly pine.

In addition to basic data on the species, the tests of the southern pine poles are designed to give a comparison between the two methods of test described in ASTM Methods D 1036–49 T.[1] Accordingly, one half of each group of poles was tested by the machine method and one half by the crib method. In the crib test, the pole is held horizontally at the base in a substantial crib simulating the ground support in service, and the load is applied through a cable attached at the cross-arm position at the top. The testing under this series of comparative tests of the two methods has now been completed but the data have not yet been analyzed.

Selection of untreated Douglas-fir poles was completed about October 1. Collection of western red cedar and lodgepole pine samples is now underway.

As yet the work and analysis of data have not progressed sufficiently to permit completion of technical data reports for distribution. Announcement of the availability of technical reports will be made in future progress reports in the ASTM BULLETIN.

Attention is called to the standing cordial invitation to contributors and others interested in the research program to visit the Forest Products Laboratory at Madison where the research is being conducted, and witness the tests at any time. Because of the fact that testing is not continuous, it is suggested that arrangements for such visits be made in advance to be sure that tests will be under way at the time of the proposed visit.

ISO Meeting on Mica

GEORGE A. PURCELL, Mica Consultant, General Services Administration, Federal Supply Service, Jersey City, represented the United States at an international meeting on Mica (ISO/TC 56) held on October 21 and 22 in Paris. Alexander S. Sperling, European Director, United Mineral and Chemical Corp., Paris, attended the meeting as an American observer.

Subcommittee IX on Mica Products of ASTM Committee D-9 is the group responsible for American participation in the work of ISO/TC 56.

[1] Tentative Methods of Static Tests of Wood Poles, 1952 Book of ASTM Standards, Part 4, p. 792.

ACR Notes

Printed on behalf of the Administrative Committee on Research

AS INDICATED in an earlier column, publicity given to the availability of "ASTM Review of Research" and "Some Unsolved Problems" resulted in a large number of requests for copies of these two reprints. Some requests are still being received.

It is of interest to note that almost 1300 requests have been received for copies of the "ASTM Review of Research." These requests have come from 48 countries all over the world, including such unexpected places as French West Africa, Iceland, Lebanon, and Pakistan. More than 400 copies of the Review were sent abroad.

The response to "Some Unsolved Problems" has been even greater, some 1700 requests having been received. Here also many copies were distributed to foreign countries, although the percentage was not as high, the ratio being about 1300 U. S. and 400 foreign.

Ceramic Analysis

One thing that the distribution of "Some Unsolved Problems" served to do was to arouse a number of comments, some of which might be construed as somewhat controversial. A typical letter is that received from the AC Spark Plug Division of General Motors Corp. which is quoted below.

"We found the compilation interesting and thought-provoking. It is apparent that unsolved problems still exist in areas in which, according to the instrument manufacturers, everything is under control. This confirms our own feelings in the matter.

"Work carried out in our laboratories which has a bearing on the problem discussed in your compilation lies in three fields:

"1. Particle size determination of finely ground oxides, clay minerals, and other ceramic materials.

"2. Spectrographic analysis of ceramic materials.

"3. X-ray diffraction studies on high-temperature ceramic bodies.

"Our work in particle size determination has been a search for a reliable, fast and accurate method of analyzing finely ground materials with characteristic particle sizes less than 5 microns. We have investigated a large number of conventional methods and find none very satisfactory. In general they give widely varying answers, they are sensitive to the type of material being tested and they are slow and cumbersome in operation. We have used the electron microscope to a small extent and believe it to be the most accurate method although very slow and cumbersome. Additional work on the electron microscope is planned for the future.

"We have spent considerable time developing spectrographic methods for the analysis of ceramic materials both for receiving inspection and production control of grinding and batch mixing. In our bodies we are concerned mainly with concentrations of less than 10 per cent and find that the spectrograph yields results of adequate accuracy in all cases. Our chemists also use it routinely for preliminary survey analysis and for supplementary checks on precipitates, wash waters, separation products, etc.

"Lately we have become interested in developing a universal method for semi-quantitative analysis of any ceramic material which would eliminate the necessity of providing sets of analyzed standards for that particular material. Results so far have been quite promising. Incidentally, this work is being done in cooperation with ASTM Committee E-2 on Spectrographic Analysis. Some of our work on ceramic analysis has been published and we expect to publish more in the near future.

"X-ray diffraction work has been carried on intensively in our laboratory, principally in the field of high-temperature bodies. Many studies have been made of the compounds and structures formed by the reactions at high temperatures between mixed pure oxides. Some of this work has also been published.

"In the spark-plug industry we have special problems of inspection, testing, and control. These arise because of the small size and complex geometry of the production part. Larger, more symmetrical test bars either cannot be produced at all or else they are not comparable with the corresponding insulators. These practical reasons prevent us from using methods of great theoretical importance such as sonic testing or tensile strength determinations. Any progress in applying such tests to small samples of complex shape would be very helpful.

" . . . We trust the above remarks will be of interest to you. We would like to keep in touch with the general activity of your group over and beyond the special ASTM projects on which we are at present engaged."

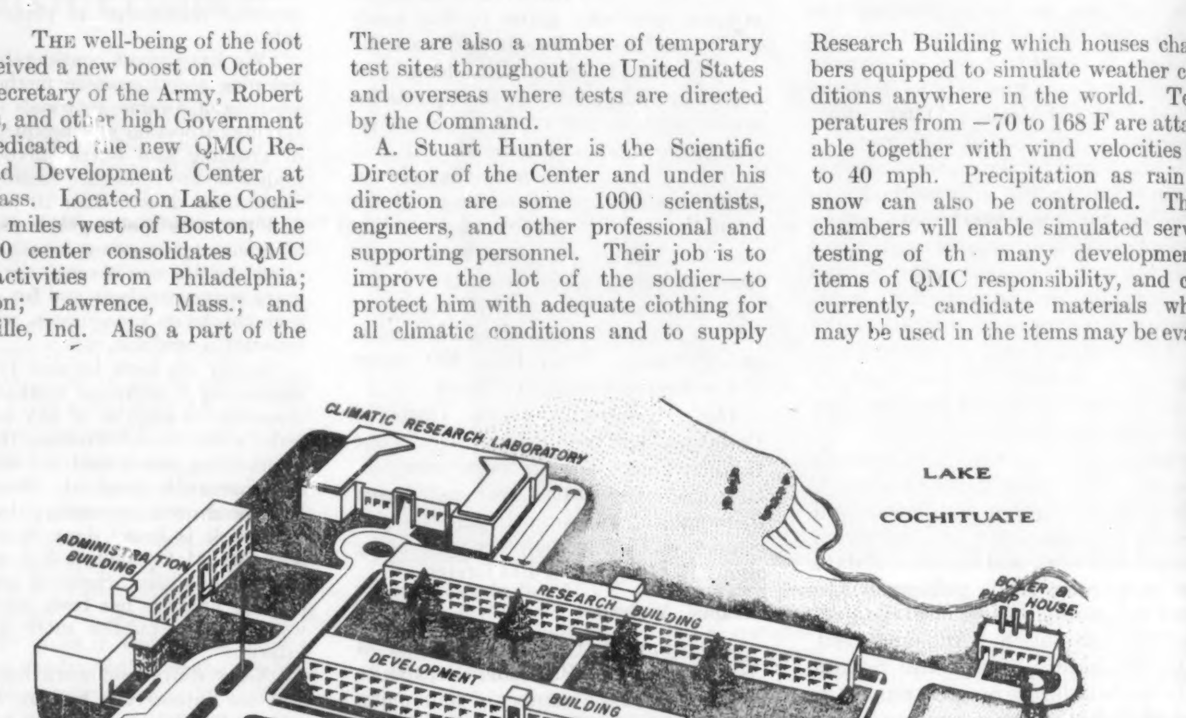
The pamphlet "Some Unsolved Problems" has recently been revised (August, 1954) and the present issue is about 50 per cent larger than the original due to the additional problems, including some from fields not previously represented. Copies may be obtained without charge by writing ASTM Administrative Committee on Research, 1916 Race St., Philadelphia 3, Pa.

Quartermaster Activities Consolidated in Multi-million Dollar Laboratories

THE well-being of the foot soldier received a new boost on October 14 when Secretary of the Army, Robert T. Stevens, and other high Government officials dedicated the new QMC Research and Development Center at Natick, Mass. Located on Lake Cochituate, 15 miles west of Boston, the $11,000,000 center consolidates QMC research activities from Philadelphia; Washington; Lawrence, Mass.; and Jeffersonville, Ind. Also a part of the QMC research and development organization but continuing as separate installations are the Food and Container Institute for the Armed Forces in Chicago, and the Field Evaluation Agency at Fort Lee, Va.

The new Center is also headquarters of the recently established Quartermaster Research and Development Command, headed by Brigadier General Charles G. Calloway. The Command directs all the QMC research and development activities including those at the Center and at Chicago and Fort Lee. There are also a number of temporary test sites throughout the United States and overseas where tests are directed by the Command.

A. Stuart Hunter is the Scientific Director of the Center and under his direction are some 1000 scientists, engineers, and other professional and supporting personnel. Their job is to improve the lot of the soldier—to protect him with adequate clothing for all climatic conditions and to supply his needs for food and portable shelter to a maximum extent consistent with the ingenuity of the scientists and engineers to design and contrive, and the industrial potential of the nation to supply.



Climatic Research

That this laboratory Center is well fitted to carry out its assignment is evident to one who is conducted through it, as several thousands were on the day of the dedication. The Center has one rather unique feature in the Climatic Research Building which houses chambers equipped to simulate weather conditions anywhere in the world. Temperatures from −70 to 168 F are attainable together with wind velocities up to 40 mph. Precipitation as rain or snow can also be controlled. These chambers will enable simulated service testing of th many developmental items of QMC responsibility, and concurrently, candidate materials which may be used in the items may be evaluated under use conditions. An indication of the size of the two chambers, one for arctic and one for tropic conditions, may be gained from the size of fans used to generate the 40-mph wind. Each fan is 13 ft in diameter and requires a 400-hp motor.

The Research Building, the largest of the ten buildings at the Center, is 500 ft long, 60 ft wide, and has three stories and basement. In it are the research elements of four divisions: Environmental Protection; Textile, Clothing and Footwear; Pioneering

Research; and Dispensing and Handling Equipment.

The Development and the Engineering Buildings are occupied by personnel of the Mechanical Engineering; the Textile, Clothing and Footwear; and the Chemicals and Plastics Divisions.

Of all the activities at the Center, those in the Engineering Building probably would be of most interest to readers of the BULLETIN. The emphasis placed on materials development and testing is evidence that the critical importance of materials performance in influencing item performance is realized by those who planned the facility.

Because all Quartermaster matériel must be transported (often by air), reduction of weight of items while maintaining functional properties and durability is a continuing objective. This has naturally led into consideration of light metals and plastics as materials of construction because of their high strength-to-weight ratios. Improvements in textiles are also a major objective of the Center. From a materials point of view, the activities in the Engineering Building can be described according to the principal material used in each.

Light Metals

Studies by the Mechanical Engineering Division have been directed toward extending the use of light metals, especially in portable and personal equipment carried by the individual soldier. Among the facilities are metalworking shops for fabrication of prototypes of such items. There are also ample facilities for metallurgical studies, including the preparation of metal specimens for microscopic examination. Also available are machines for determining such physical characteristics of metal as hardness, tensile, and flexural strengths, and resistance to corrosion and deterioration from exposure to climatic extremes. Testing machines are in air-conditioned rooms to conform to the requirements of standard test methods of the ASTM, Federal, and Military Specifications.

Another interesting and useful project has been the development of X-ray equipment for inspection of the quality of canned foods. A demonstration prototype unit showed clearly that defective cans could be detected without removing cans from the cartons. Developments are going forward on this unit so that it may be used for inspection of warehouse stacks without disturbing the stacks.

Plastics and Rubber

Considerable space has been set aside in the Engineering Building for pilot-plant investigations on plastics and rubber by the Chemicals and Plastics Division. Compounding and sample fabrication facilities include a rubber mill, a four-roll inverted calender, a coating machine and, several hydraulic presses.

Several years ago the Quartermaster Corps was directed to assume the responsibility for research in low-temperature rubber for the Department of the Army. As a result of this assignment, the QMC has developed, in cooperation with several outside laboratories, an elastomer having superior properties at low temperatures as compared with GR-S synthetic rubber or natural rubber.

The favorable strength-weight ratio of reinforced-plastic materials is being exploited by the use of these materials in such items as arctic sled boats, pack boards, bread boxes, foot lockers, etc. Other current uses for plastics include tableware and buttons.

Unsupported film and coated fabrics are being investigated fully by the QMC for a number of possible applications. Film has possibilities for protective clothing and as protective covering for equipment in addition to its obvious use in food packaging. Coated fabrics are used for rainwear and to a limited extent in tentage.

The QMC has for some years maintained extensive testing facilities for plastics and especially for films and coated fabrics. Quartermaster personnel have been active on ASTM committees in helping to work out test methods for these materials and the Society is indebted to them for this assistance and cooperation. Test facilities for plastics and rubber include various conditioned rooms and machines for determining physical properties of plastics and rubber. Accelerated weathering equipment is also available.

Other products under the Chemicals and Plastics Division are detergents, fungicides, rodenticides, germicides, pretreatments, protective finishes, paper and paper products, adhesives, and laminated plastics such as those designed to afford bullet protection as in the Quartermaster body armor.

Textiles

Two major activities in textiles centered in the Engineering Building are the Dyeing Laboratory and the Tentage and Equipage Branch. Additional space for the Textile, Clothing and Footwear Division is required in the other buildings for work on textile engineering, functional finishes for textiles, leather technology, and design of textile items.

Extensive testing facilities are available for determining the properties of textiles. These include both the more conventional machines for properties which have been well defined and standardized, and also some instruments for making measurements of a research nature such as the elusive factors affecting comfort or other characteristics of a classified nature.

Quartermaster personnel working in the textile field have cooperated with ASTM in working out methods for testing textile materials and because of their wide experience in this field have been able to make substantial contributions.

Test Coordination

As mentioned above, the field testing is carried out by the Field Evaluation Agency with headquarters at Fort Lee, Va. However, all the field testing is coordinated from a central office at the Center and headed by Gerald C. MacDonald, a long-time member of ASTM. There are test sites at a number of geographical locations to obtain conditions representative of all the climatic extremes to be found in the world. At Mt. Washington, N. H., and Fort Churchill, Manitoba, severe winter conditions are encountered and at Yuma, Ariz., and the Canal Zone, desert and jungle conditions are met. Although these sites may be used for direct exposure of materials or developmental items to the elements, a more important and revealing test is usually run where the items are tested under simulated fighting conditions, and their performance is measured together with the effects of the items on the soldier. The soundness of sleep in a sleeping bag and the rest provided the sleeper may be more important under field conditions than the tensile strength of the fabric outer covering or the fading characteristics of the dyes used.

Conclusion

In a brief report all the features of the Center cannot be mentioned. The Center is modern in every respect and it is reassuring to know that such careful regard is being given to the welfare of the soldier—that he can defend his country when necessary with the maximum assistance and backing that the ingenuity and productive capacity of the nation can provide.

Random Samples . . .

FROM THE CURRENT MATERIALS NEWS

From the broad stream of current materials information flowing from "in-box" to "out-box" in a busy editorial office, random samples (mostly random) have been plucked. Thinking them worth re-showing to ASTM'ers who may have missed the original articles, we have included them here. Of course, we had to trim the samples to fit. There will be those who are not satisfied with samples, especially ones which are not really random. But these ASTM'ers can contact the institution, magazine, governmental agency, etc., who placed the original information in the stream. We have quoted literally, sometimes without quotation marks where the point of omission is obvious, and we have given credit to the source. These credit lines are also for the use of ASTM'ers whose entire curiosity has been aroused.

The New Interference Microscope

General Motors Research Laboratories is pioneering in the industrial use of a new type of microscope that measures "peaks" and "valleys" ranging from two to 100 millionths of an inch.

Known as the interference microscope, it appears promising not only as a research tool but also may become a quality control instrument where microscopic smoothness or roughness is important in industry. It adds the dimension of depth to the art or practice of examining microscopic surfaces, a dimension ordinary microscopes cannot measure. The optical interference principle by which the microscope operates is not new. However, industrial application of the microscope to surface finish details of such minuteness is a new development.

Briefly, the interference or split beam principle is described as follows:

A beam of light is directed into a block of glass or "beam splitter." The light is split into two parts, with one part being directed through a lens to a flat reflecting surface.

The other part of the beam is directed downward through another lens where it is reflected from the surface of a specimen under examination.

After being reflected from the flat reflecting surface and from the specimen surface, the two beams return through their respective lenses to the beam splitter where they recombine to form an "interference pattern."

The pattern appears as a series of lines—even and parallel if the surface is smooth, or zebra-like, wavy, and jagged if the surface is uneven or marred by machining marks or scratches.

The pattern can be viewed through an eyepiece similar to the eyepiece of a conventional microscope.

Thus, depth of scratches or peaks and valleys of an unsmooth surface can be measured by their deviation from the straight-line patterns obtained from smooth surfaces.

Already the microscope has been used to measure plating thickness, to determine leveling abilities of plating materials (that is, how they smooth a surface by filling in irregularities), and to study effects of weathering on painted surfaces.

It likewise has been used to control precision roughness standards. These are used throughout industry to standardize machined surfaces of bearings, cylinder walls, piston liners, valves, and other highly machined, close fitting parts in automotive and aircraft engines.

Another use has been to check corrosion pits and other defects on plated parts and other surfaces such as cylinder bores and bearings.

In this era of precision machinery and highly decorative finishes, many surfaces require the sensitivity of the two-beam interference microscope which can detect surface variations as small as two millionths of an inch.

•

A New Mold Material for Non-Ferrous Castings

The United States Gypsum Co. research engineers are of the opinion that its new casting plaster "Hydroperm" is the answer to one of the age-old quests in metal casting, namely, a quickly produced mold with the smoothness of plaster and the permeability of sand.

By using the Hydroperm type of plaster formulation and a new mixing technique, molds are made with a plaster-like smoothness on the surface, "backed up" by a rigid, sponge-like mass of cellular plaster. Such molds, with the smoothness of plaster and the permeability of sand, offer the following advantages:

1. Molds may be poured by gravity. Heads and gates may be planned scientifically according to good foundry practice.
2. Calcination of the mold is not required. Steam formed during the pouring operation escapes readily through the permeable plaster mold.
3. Molds are more "true to size" since calcination is not necessary. High temperature "burn-out" is not required. Mold shrinkage thus is minimized.

Properly made molds of Hydroperm plaster have a permeability range that can be varied and controlled to meet the customary permeability requirements of many non-ferrous metals and alloys. By whipping or mixing sufficient air into the plaster-water mixture, a porous structure of small uniform cells approximately 0.01 in. in diameter is created.

•

300 Per Cent Increase in Magnesium Corrosion Resistance

Magnesium, one of the modern metals with great potential, has been restricted to a degree in its application because of its susceptibility to corrosion. There now appears to be a solution to this problem through a new impregnating process that has increased the metal's resistance to corrosion from 300 to 400 per cent. Impregnated samples were subjected to continuous salt spray for periods up to 125 hr with no evidence of pitting or metal failure.

Magseal, as the new process is called, was developed by the Nu-Line Plastic Impregnating Co. of Los Angeles after two years of research. This new process may prove to be an important step in furthering the use of both magnesium sheet and castings in modern industrial design and production.

With this increased corrosion protection around critical areas such as precision-fit spots where dissimilar metals touch, and in alloy castings with temperatures around 450 F, much greater flexibility in the utilization of magnesium is anticipated. This new process already has been found to be particularly effective as a corrosion protective medium for airborne radar equipment

and camera and instrument parts. With proper resistance to corrosion, magnesium castings can be incorporated in many more phases of aircraft construction than ever before.

Magseal is a resin combination that impregnates the metal in much the same manner as conventional impregnation, yet gives greater protection in the critical areas where dissimilar metals contact the magnesium.

•

Simple Pre-Marking Method Speeds Up Testing of Fabrics

A THREAD is speeding the testing of material at the Corps of Engineers' Research and Development Laboratories, Fort Belvoir, Va.

The thread in a contrasting color is run through test fabrics during their manufacture to mark off the size of test samples. This makes it a simple matter to cut the material into the sizes required for weathering, fungus resistance, exposure, or other tests run at the Laboratories on material under consideration for use in Engineer equipment.

The pre-marking eliminates the time-consuming hand measuring and marking of the samples that previously had to be done by the project engineers.

The method is also being used by Quartermaster and other Government agencies and commercial firms engaged in material testing. A patent application on the process has been filed.

Question: Does Your Company Make or Use Seamless Brass Boiler Tubes?

AT the October 5 meeting of ASTM Committee B-5 there was considerable discussion regarding ASTM Specification B 14 for Seamless Brass Boiler Tubes.

In view of the fact that this specification had originally been adopted in 1918 for the purpose of making a material specification available to manufacturers and users of locomotive boilers, serious doubt was expressed in the meeting as to whether this material was still being used today.

To guide the committee in deciding whether Specification B 14 should be maintained or withdrawn, a task group has been appointed under the chairmanship of M. F. W. Heberlein, Staff Metallurgist, United States Metals Refining Co., Carteret, N. J.

The readers of the BULLETIN are requested to write Mr. Heberlein if they know of any use of this material. Any such information will aid the task group in the performance of its duties under this assignment and will therefore be greatly appreciated.

A block of treated southern yellow pine is removed from a jar of topsoil in U. S. Steel's Pittsburgh laboratory where it has been in contact with a wood-destroying fungus for 12 weeks. After scraping off the growth, the block will be dried to its original moisture content and weighed. Weight loss determines the protective value of the wood preservative under study.

X-Ray Diffraction Cards—Special Projects Expanding

IN 1949 a Research Associateship was established at the National Bureau of Standards to eliminate conflicting data in the X-ray diffraction card file sponsored by the Joint Committee on Chemical Analysis by Powder Diffraction Methods. This project is also developing diffraction data for other materials when found desirable. Since the beginning of the card file in 1939 W. P. Davey of The Pennsylvania State University, Osmond Laboratory, has been its editor. In this capacity his office has collected data from special contributors and from the literature. By far the largest single contributor has been the British Institute of Physics. The Joint Committee furnishes the British Institute of Physics copies of the card file which the Institute sells in the British Isles using the money to develop new data.

In 1953 the Joint Committee hired three associate editors for the card file: Dr. Brindley of The Pennsylvania State University, Dr. Post of the Polytechnic Institute of Brooklyn, and Dr. Weissman of Rutgers University. These associate editors review the data going into the card file, promote submittal of new data, and stimulate work by other laboratories.

Also in 1953 the National Association of Corrosion Engineers became a cooperating member of the Joint Committee and will furnish diffraction data for the card file.

This year a special project for developing data on minerals was organized under the direction of Dr. Brindley. This project is contracted on a yearly basis.

Also in 1954 Dr. P. M. deWolff of the Technisch Physische Dienst TNO En T. H., Delft, Netherlands, has been allocated funds by TNO for establishing new powder data for the card file.

An Editorial Board has been organized by the Joint Committee to coordinate the work of these widely separated projects. The chairman of the Editorial Board is W. L. Fink, Physical Metallurgy Division, Aluminum Research Laboratories, Aluminum Co. of America.

The Joint Committee is vitally interested in the development of new X-ray diffraction data and the submittal of data which have not yet appeared in the literature. It will welcome any information on such data.

The Professional Development of Technical Men*

By R. J. S. Pigott

THE last war and conditions since then have shown us plainly that the development of a young man into a good engineer, chemist, or pure scientist begins much earlier than his formal technical education in college. In many cases an interest in science or engineering develops as early as ten or twelve years of age. This interest does not necessarily imply talent. However, since we shall definitely be short of technical graduates for a period of at least ten years, this early indication may be valuable in increasing enrollment in technical schools.

The grade school and high school have some influence since the character of the teaching varies very greatly. One thing appears evident—our present-day grammar and high schools are not teaching as well as they did 50 years ago. Our children, as a rule, do not spell or figure as well as their parents and do not not appear as well grounded in history, geography, or languages. Something will have to be done to get the three R's back in place, with less time wasted on "frill" subjects.

At the high school level, the Engineers Joint Council has been carrying on a definite campaign to interest students in a technical career, to increase the output of engineers four or five years from now. In the home, the father's profession usually has considerable influence on the son—if he is an engineer the son is likely to be strongly pointed toward the same line, since the father's interests, conversation, and usual circle of friends will all lead him in that direction.

The young man's own general attitude may influence his choice—whether he is curious and wants to know why and how things work, wants a reputation, or wants to make money. In the first and second cases, he may be good engineer material; in the third, he will probably avoid engineering. I usually rate engineering, management, sales (and advertising), and financial occupations in a rising scale of reward for the effort. We are becoming conscious that the first two have been underpaid for their results, and the last two, much overpaid. The present shortage of engineers will help to readjust that situation.

* Presented at a joint meeting of the ASTM New York District, The American Society of Mechanical Engineers, and New York State Society of Professional Engineers.

Technical Education

Our technical institutes and colleges have had hard going for a generation because of the increasing demand for specialized courses, often in greatly narrowed fields of engineering or pure science. The result has been too many courses and not enough basic material, making the teaching difficult.

Many colleges have tried courses up to six years long, but for practical reasons, these are far from satisfactory. Four is about all we can really afford, except for advanced degrees, which are chiefly useful for pure science and chemistry, but of very little use in engineering. I feel we need to return to the three R's of technical education—physics, chemistry, and mathematics—and eliminate cultural fringe material. In this way, we can do a good *technical* job in four years. In the curriculum we need only divide engineering into the four major groups: civil, mechanical, electrical, and chemical, putting different emphasis on the three basic subjects to suit each course. Practical application should be largely completed in summer sessions. After a graduate has had his four years of basic technical education, coupled with practical application every summer and five years of earning money in an engineering job, he can specialize in any line he wants in six months. It is much better done on the job in a company interested in a particular specialization than anywhere else.

The principal objective of technical education, other than injecting a quantity of basic facts, is to teach a student to reason—or at least to begin to. Nearly all primary education is memory exercise with very little reasoning involved. But to make a sound technical mind, we need not only the basic memory material, but the ability to reason from these facts to a conclusion—very often a new conclusion.

The practical work in college should form the link between the classroom and the factory illustrating application of theory. An engineer ought to have enough shop, power-plant, and construction work to teach him to use his hands, and to set his mind to solving problems by reasoning from his theoretical studies.

The Professional Attitude

There is no yardstick for mental performance—one can judge only by final results. Technical work is nothing like that of the skilled artisan—so many brick per day, so many pieces per hour, so many feet of weld—consequently, it is extremely difficult to set a standard for performance when the only criterion is judgment applied to a completed task, which may have taken from a few days to many months. This reveals one of the main differences between a profession and a craft.

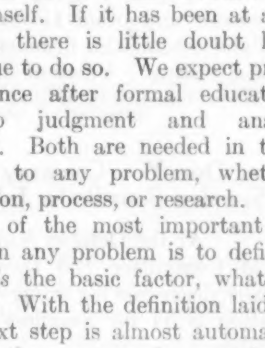
Since the technical man deals almost exclusively with facts and laws of physics, he has an automatic training in strict honesty. The "artistic conscience" still persists in all scientific and engineering work although it has almost disappeared in many other lines of endeavor.

Another characteristic of the technical professional is that of completing a task regardless of the reward.

Mental Development

The technical school is assumed to have started the technical man thinking for himself. If it has been at all successful, there is little doubt he will continue to do so. We expect practical experience after formal education to develop judgment and analytical faculty. Both are needed in the approach to any problem, whether of operation, process, or research.

One of the most important initial steps in any problem is to define it—what *is* the basic factor, what is the scope? With the definition laid down, the next step is almost automatic—to search the memory for experience on



R. J. S. PIGOTT, Consulting Engineer, was for 23 years Director of Engineering Research at Gulf Research and Development Co. and previously, Professor of Steam Engineering at his alma mater, Columbia University. He is a past-president of ASME and SAE.

similar problems, thus laying out a plan of attack. If previous lines of attack have not been wholly satisfactory, it is necessary to use imagination and synthesis, to devise or invent new ways of solution. Initiative in working up lines of attack and decision in choosing the best lines must come along with analytical faculty, judgment, and imagination. We have all seen the young engineer who freely produces several methods or designs for the solution of a problem, then cannot decide which one to use. It is also important to know when to *stop* improving a process or design, and put it into effect. For example, the first 15 years of commercial use produced 80 per cent of the gain in the Btu rate in steam turbines and internal combustion engines; the next 30 only advanced it the remaining 20 per cent, at a cost higher than the earlier 80 per cent.

Administration

For the development of analytical powers, judgment, decision, and imagination, the work itself is the best teacher, but the superior can greatly accelerate their development and increase the quality and quantity of the work of a subordinate. The influence of superiors in the development of technical men is enormous. We respond to prompt, decisive direction and we can be discouraged by vague or impatient instruction. Personal characteristics of the superior are likewise important. Good temper, humanity, friendliness, and consideration cost nothing but they can produce astonishing results in the development and output of the young engineer.

Delegation of authority is also extremely valuable in leading the young employee forward. I was lucky enough to have a first boss who had an extraordinary willingness to load me with responsibility and authority until my legs would begin to buckle, just short of folding up. He would not allow me to bring to him a decision I was capable of making myself. In all technical occupations the contribution of the individual is highly personal, involving much more than a mechanical skill; therefore, responsibility and the authority to do (even if limited) are greatly valued by the recipient. Appreciation and encouragement are most effective coming from the superior.

Another and less direct effect of the supervisor's direction and instruction, likewise based on his personal characteristics, is the improvement of relations between the subordinate and his fellow workers. It is generally true that the personal characteristics of the head of any group or division will ultimately be reflected in his entire force. Men go to school all their active lives, with the superior in their business substituted for the school instructor. So it is quite natural that the superior-teacher, *via* his mental powers as an engineer and very noticeably by his personal characteristics will mold his associates.

National Technical Societies

One of the most valuable means of increasing technical knowledge and developing good professional attitude is work in the technical societies.

Technical committee work is a postgraduate course in technology since one finds in these committees the very best brains and the latest data. The technical papers are a mine of information, in the most reliable state, and probably the earliest—textbooks are always one or two years behind the event. Working on committees is valuable in developing a good personal attitude. The "give and take" of committee work, especially since the committees always have a large percentage of skilled and successful men (all working voluntarily), gives the younger technical man a wonderful training in the habit of cooperation, and in the "persuasive" methods of doing business.

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>
> ***Technical committee work is a postgraduate course in technology since one finds in these committees the very best brains and the latest data.***

Writing technical papers is a splendid source of training in exposition of his subject, and in addition affords the writer the satisfying feeling that his work is recognized.

The Engineer and the Social Structure

Engineering and other technology are now so large a part of our pleasant civilized existence that it is difficult to find any class of activity contributing so much to our daily convenience. Good water supply, power, transportation, food in finished form, communication, defense, are all primarily dependent upon engineers or chemists, or both. There has therefore been a strong tendency to argue that the engineer should take a prominent part in the political life of the country. This thesis needs very careful examination.

Government undertakings that involve largely engineering such as water supply, roads, irrigation, reclamation, and public power should be handled by engineers. Most of these projects are best handled with Government by large bodies of engineers, such as our national societies. These cannot be successfully accused of bias or political intent, and contain a mass of the highest skills in the country; individual effort is, in these fields, ineffective. At the local level there is much that a local engineering society can do to help the operation of its municipality.

But all of this is impersonal, and on the engineering side; no political aspect is out in front. There are, as mentioned before, two characteristics of technical men that would be useful in government—inherent honesty and training in sound reasoning—but these are useful in any line of endeavor, and likewise are not limited to technically trained men.

There is no special reason why the engineer should enter politics *because* he is an engineer. An engineer should enter politics when he feels he has a civic duty he can perform effectively, and when he has a bent for the kind of administration required in Government—and so should any other professional.

To summarize we may perhaps say that the development of a sound attitude in any technical profession involves: (1) honesty, dealing with facts only, no tampering with the formula, (2) reasoning ability enhanced by practical experience, and considerably enhanced by sound direction from above, (3) decision and imagination—greatly aided by delegation of authority and encouragement from above, and (4) personal relations with others, very largely influenced by superiors.

From the foregoing, it becomes rather clear that the development of professional attitude in technically trained men is largely the responsibility of their superiors. Of course we have a percentage of strong minds and strong characters that can develop without much external guidance, but this does not apply to the bulk of our technical graduates. But it is apparent that character in superiors is more important than technical skill. Therefore, this one is up to management.

The Responsibility of the Engineer to His Profession*

By W. H. Larkin

PROFESSIONALISM in any area of endeavor is strictly a grass roots affair. Engineering is no exception. It is basically a way of life, an understanding of the nature of a profession, a realization of its responsibilities, and a willingness to assume a fair share of them.

A professional man applies special skills at an intellectual level, based on fundamentals usually learned in school. Members of the professional groups take exceptional pride in the quality of their work, without regard for the compensation. In most cases their reward in worldly goods is small indeed when compared to the promoter's profit.

The professional engineer, by the very nature of his work, must assume high individual responsibility in connection with the safe, economical use of large investments. He must inevitably share in the supervision of the educational process that produces young engineers. He must also participate in the orderly establishment of current standards to be shared alike by all industry. Professionalism is not a matter solely of possessing a registration card given by a state examining board, nor is it a matter of carrying a membership card in one of our many technical societies. Altogether too many individuals in both groups have no conception of what constitutes the professional attitude nor what their responsibilities are. The profession is all too sterile at the grass roots, the only level at which vital lasting growth can take place.

The Engineering Schools

The neophyte may ask with some justification where he should start in his endeavor to become a professional man willing and able to pull his weight. I would tell him to acquire an understanding of some of the problems that face the engineering school from which he graduated. The questions he should ask himself are: Should the curriculums be four, five, or six years in length leading to the first degree in engineering? If one or two years are added, should they be devoted to humanities to the end that the engineer may become a better citizen, or to special technologies that he may be useful to industry with less on-the-job training? Are special technologies better taught by industry or by an engineering school, and if the latter, can instruction ever keep pace with the progress made by industry?

The graduate should develop an appreciation of the financial needs of his alma mater. To what extent is their budget dependent upon the annual giving of the alumni? Is their program heavily subsidized by Government grants, and hence so restricted as to be of little value to a graduate group seeking opportunity for scholarly research? Would there be a financial crisis of major proportions were the Government grants withdrawn? Many of these problems will be the concern of the alumni association which the young engineer will be well advised to join.

Engineers Council for Professional Development

The letters ECPD stand for the words Engineers Council for Professional Development, truly a committee of the engineering profession. The contributions this council has made to the professional way of life are monumental. To name but one, their work in the field of accrediting engineering curriculums should be studied by every young engineer entering the profession. Add to this a familiarity with the Canons of Ethics drawn up by ECPD, and the neophyte has made progress toward understanding the true meaning of professionalism.

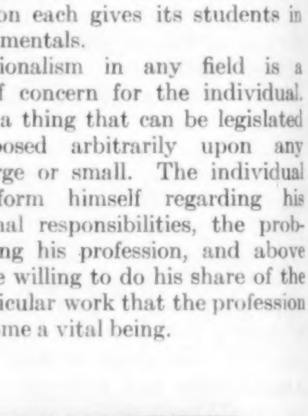
Membership in the dominant technical society in one's field of interest is also a must. These societies establish the working standards for industry in many fields. Consider, for example, the work of the ASME in the subjects of fuels, gas, turbine power, heat transfer, and machine design, to name but a few. It is the responsibility of every mechanical engineer to support through membership the programs in the several technical areas.

Professional Engineer Licensing

Obtaining the professional engineer's license is a basic part of the qualifying process of the recent technical graduate, just as is passing the bar examination for the lawyer, or the medical examinations for the intern. It is essential that the young man know something of the philosophy back of licensing, know the requirements of his local state law, and realize that it is administered by a board of examiners, themselves registered engineers of not less than ten years' experience. The young engineer should know that all who meet the requirements of the law in New York are given an opportunity to qualify for their license. We do not use the law as a device to limit the number of engineers in the State, to run a closed corporation.

The graduate of an accredited curriculum may ask why he should be called upon to take the E-I-T examinations—why his diploma does not entitle him to that status automatically. We of the board would like to see that happy state come to pass, but we cannot yet recommend such recognition as long as only 25 per cent of the candidates from curriculum A pass, and 90 per cent from curriculum B pass. Both curricula are accredited, yet there is an obvious difference in the preparation each gives its students in the fundamentals.

Professionalism in any field is a matter of concern for the individual. It is not a thing that can be legislated and imposed arbitrarily upon any group large or small. The individual must inform himself regarding his professional responsibilities, the problems facing his profession, and above all else be willing to do his share of the extracurricular work that the profession may become a vital being.



WILLIAM H. LARKIN, Air Preheater Corp., is a past chairman of the New York State Board of Examiners for Professional Engineers and Land Surveyors, past president of the Harvard Engineering Society and the New York State Society of Professional Engineers.

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* Presented at a joint meeting of the ASTM New York District, The American Society of Mechanical Engineers, and New York State Society of Professional Engineers.

Relation Between Compressive Strength and Rate of Deformation in Testing Swedish Fir

By Bengt Norén

Tests carried out at the Swedish Forest Products Laboratory to determine the influence of testing speed on the compressive strength parallel to the grain indicated that strength increases in ratio to logarithm of rate of deformation.

The deformation of wood under the action of a force can be an instantaneously elastic deformation, a retarded elastic (visco-elastic) deformation, or a permanent deformation—that is, plastic flow. As long as the total deformation is instantaneously elastic and provided that the gravity forces can be neglected, there is no need to be concerned with the influence exerted on the strength by the loading speed in laboratory tests, or with creep in structures subjected to the dead load or to other long-time loads. Unfortunately this is seldom the case, and the time factor has generally to be considered in the testing of wood and wood constructions.

The mechanical behavior of wood is closely related to the wood structure, but this relation so far is not known in detail. Wood is built up of several types of units from fibers to cellulose chains. When wood is stressed, all these units are deformed and displaced. The disintegration of the cell walls (order of thickness 10 μ) can take place in different units (**7,9,11**).[1] There is a thin outer primary wall (cambial) and a thicker inner secondary wall. The secondary wall is built up of concentric lamellae composed of cellulose fibrils (width 0.4 to 1 μ), which consist of discrete thin filaments, elementary fibrils, or micelle strings, about 100 Å in diameter, and which are supposed to contain 240 cellulose chains. Furthermore, the micelle strings have been assumed to be composed of crystallized strands or micelles of certain width and length, separated by paracrystalline regions, although the existence of definite micelles has so far not been convincingly proved by experiments.

The instantaneously elastic component of the deformation may be expected to be due to deformations in the crystalline parts of the micelle strings and, on the time-scale of our experiments, possibly also to deformations in the amorphous regions of the micelle strings. In the amorphous regions a stress can cause two types of displacements: a microbrownian displacement—bending of the molecules—and a macrobrownian displacement—sliding of the chains in relation to each other. The former displacement is elastic, though the recovery after the load has been removed may be more or less retarded (elastic after-effect). The latter displacement is not reversible and produces pure plastic flow in the material. Retarded elastic deformation can also be caused by strain in the micelle strings, but only in the disordered ranges, and there is a theoretical possibility that pure flow can also occur in these ranges. Furthermore, it is probable that the micelle strings are unbranched units consisting of cellulose chains—that is, that no chains cross from one string to another. Therefore a shearing stress may cause the strings to slide; this results in retarded elastic deformation or in plastic flow. In the same way a shearing stress may cause sliding of the larger structural elements—the fibrils, the concentric fibril lamellae, and the fibers.

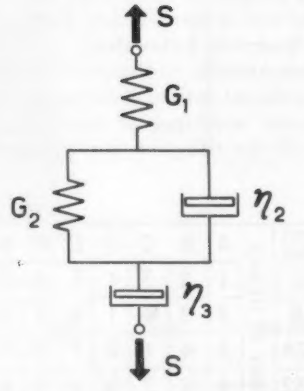

Fig. 1.—A Mechanical Model Consisting of Springs and Dashpots to Describe Deformation of Elastoplastic Materials.

G_1 = instantaneously elastic deformation.
G_2 and η_2 = retarded elastic deformation.
η_3 = flow.

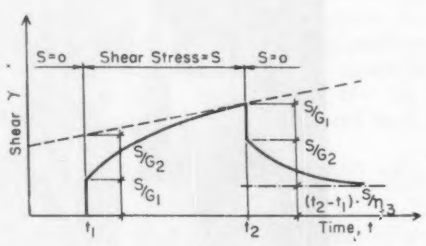

Fig. 2.—Shear Effect Represented by the Rheologic Model in Fig. 1.

G_1 = modulus of instantaneous shear.
G_2 and η_2 = a retarded elastic deformation.
η_3 = a coefficient of viscosity representing the rate of irreversible flow.
The shear force acts during the time interval from t_1 to t_2.

The resolution of the deformation of wood into an elastic component and a plastic component is important in determining the relation between the ultimate strength and the rate of loading. If the stress increases rapidly, the viscous parts of the structure will remain firm. Then the elastic deformation will be predominant, and the stress may reach a high value before the material fails. On the contrary, if the load is applied during a comparatively long time, the viscous elements will yield so that the elastic cellulose chains will have to carry a greater part of the load. The ultimate stress or strength of instantaneously elastic cellulose is independent of the time, but if the viscous parts of the cross-sectional area offer little resistance to the load, then the nominal strength of the material, expressed in terms of the ultimate load divided by the total cross-sectional area, will of course be less.

The visco-elastic behavior of a mate-

BENGT NORÉN, head of Timber Mechanics Section of the Wood Technology Department, Swedish Forest Products Research Laboratory, Stockholm, has specialized in design and strength of joints in timber construction, stress grading of timber, and creep in wood and wood joints.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] The boldface numbers in parentheses refer to the list of references appended to this paper.

Fig. 3.—Sawing of the Log into Sticks.

Cutting out of prisms from sticks Nos. I to VIII is shown in Fig. 4.

rial is sometimes described by means of a mechanical model comprising springs and dashpots (Figs. 1 and 2). If there exists a certain strain level that is independent of the loading time and which corresponds to failure, then the ultimate load and its dependence variation with the loading speed or with the duration of load can be determined from the same model and its displacement equation. However, it has proved difficult to find a model that is completely analogous to wood in describing low as well as high strains, and no attempt to deduce a general equation of the relation between the strength of wood and the rate of loading will be made in this paper.

Tests on wood and similar materials have shown that the *ultimate load* is directly proportional to the logarithm of the *rate of stress* (log dS/dt) and, in creep tests, to the logarithm of the duration of load. The tests reported in this paper indicate that the ratio of the ultimate load to the logarithm of the *deformation speed* is constant (dS = const dR/R).

The purpose of these tests, which were carried out at the Swedish Forest Products Research Laboratory, was (1) to find some simple method of testing wood at a constant rate of deformation in the hydraulic machines of the laboratory and (2) to discover the possible influence exerted on the recorded strength of the specimens by the choice of the rate of deformation. The rate of deformation was not extremely high or low and was approximately within the limits given in the Food and Agricultural Organization recommendations.[2] In short, the rate of deformation was suitable for static routine tests in a testing machine of ordinary capacity.

This investigation supplements an earlier study made at the same laboratory by Perem (6), who for the most part used a constant rate of loading instead of a constant rate of deformation.

Test Specimens

The tests were carried out on Swedish fir (*Pinus silvetris*) and were limited to an investigation of the strength parallel to the grain. The specimens were prismatic, 2.5 by 2.5 cm in cross-section and 7.5 cm in height in the grain and load direction. (The F.A.O. Conference recommends that the length-breadth ratio of the compression-parallel-to-grain test specimen shall be within the range from 2 to 4 and that the cross-sectional dimensions shall be 2 by 2 cm, 2.5 by 2.5 cm, or 5 by 5 cm.)

Eight sticks (Nos. I to VIII) were cut from a fir log (Fig. 3). After seasoning

[2] First Conference on Mechanical Wood Technology of the Food and Agricultural Organization of the United Nations, Geneva (1949).

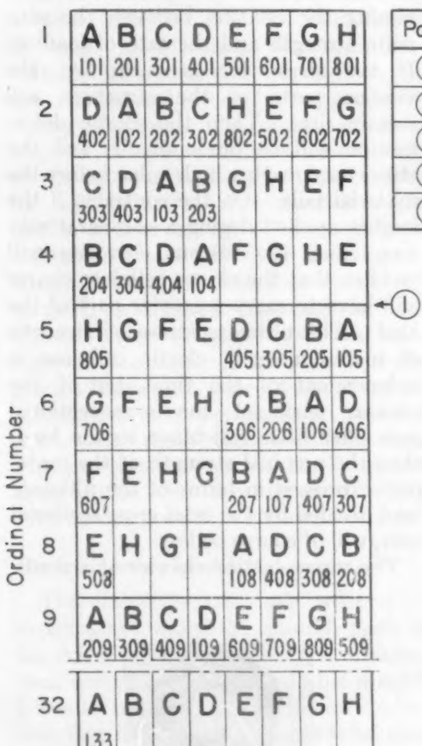

Fig. 4.—Cutting Out 288 Prisms in Eight Groups of Similar Wood Quality.

Part	Ordinal Number		A	B	C	D	E	F	G	H
①	1 - 8	Number of Group	1	2	3	4	5	6	7	8
②	9 - 16		2	3	4	1	6	7	8	5
③	17 - 24		3	4	1	2	7	8	5	6
④	25 - 32		4	1	2	3	8	5	6	7
⑤	33 - 36		1	2	3	4	5	6	7	8

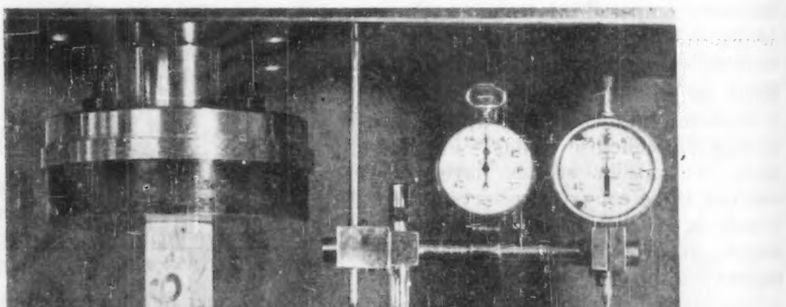

Fig. 5.—Device Used to Control the Rate of Deformation.

The displacement of the machine crosshead is magnified and transmitted by a lever to the dial gage (right). This gage is furnished with the time scale: 1 turn (= 1 mm) = 60 sec—the same scale as that of the stop watch (left). The oil supply to the loading cylinder of the testing machine is so adjusted that the pointer of the dial gage follows the hand of the stop watch. Accordingly, if the lever ratio is 1:1, the specimen is loaded at a speed of 1 mm per min, and so on.

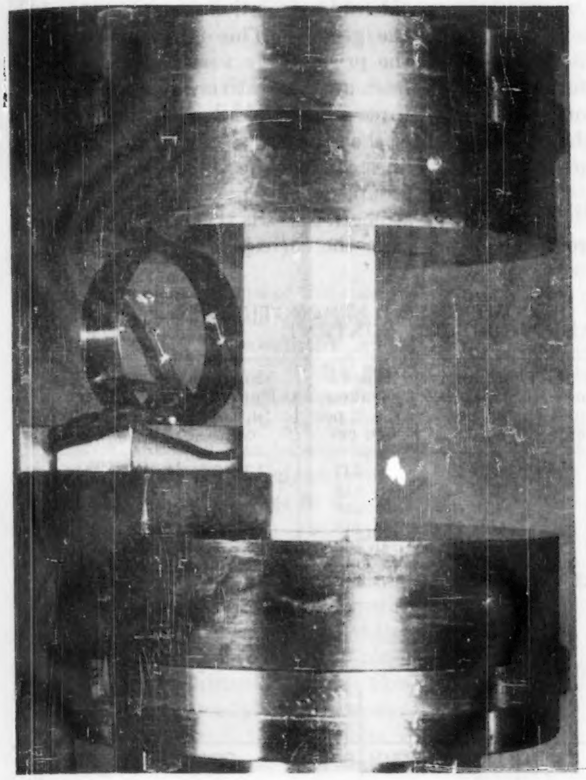

Fig. 6.—Electrical Stage for Controlling Rate of Deformation.

It consisted of a thin steel ring provided with four wire strain gages (two on the inside, two on the outside), which were connected in a Wheatstone bridge. The readings were taken on a galvanometer which was connected to the bridge diagonal. Different scales were used for different rates of deformation. The main disadvantage of this instrument is that the bridge had to be rebalanced a couple of times during a test to failure, but this did not cause any trouble at those low rates of deformation at which it was used.

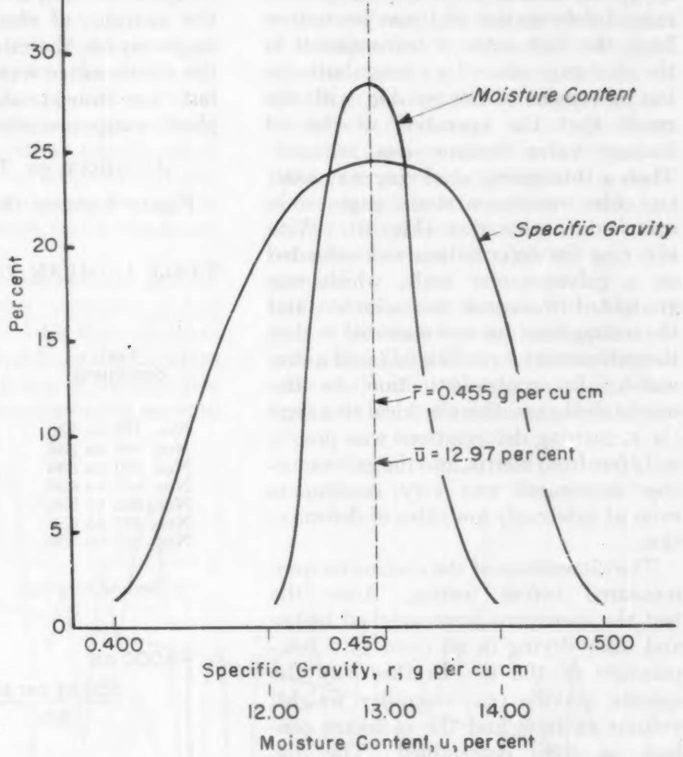

Fig. 7.—Distributions of the Moisture Content and the Specific Gravity of the Test Specimens.

The scales of the axis of abscissas are proportional to the changes in compressive strength caused by changes in moisture content and in specific gravity. The shape of the curves indicates that the influence of variations in moisture content on the deviation in strength ought to have been small compared with the influence of variations in specific gravity.

to a moisture content of 12 per cent (based on the weight of dry wood), the sticks were planed to 2.5 by 2.5 cm in cross-section. The logs were sawed and the sticks were planed so that every cross-section of the sticks, and hence all the specimens that were cut off later, should insofar as possible contain the same annual rings. The end surfaces of the prisms, 7.5 cm in length, were carefully trimmed in order to eliminate their local deformations during the test.

The number of prisms was 288. Figure 4 shows the method of selection used for obtaining eight groups (Nos. 1 to 8) of 36 specimens each. On the assumption that the variation in strength of specimens in the same cross-section of the log is linear from stick No. I to stick No. VIII and that the variation in strength in a stick is directly proportional to the position of the specimen in the longitudinal direction, the eight groups are equivalent in strength. (This result could also have been obtained by means of a simpler selection system, but an advantage of the system used in these tests is that it is relatively insensitive to nonlinear strength variations in the longitudinal direction.) The test specimens are numbered as follows: the first digit is the number of the group to which the specimen belongs, and the two last digits express the ordinal number of the specimen in the group. At the same time, this number indicated the position of the specimen in the longitudinal direction of the log, reckoned from the root end (butt end).

Scope of Tests and Method of Testing

The compressive strength was determined at five different rates of deformation as shown below:

Test Specimens	Rate of Deformation, mm per min
Nos. 101 to 136....	3
Nos. 201 to 236....	1
Nos. 301 to 336....	0.3
Nos. 401 to 436....	0.1
Nos. 501 to 536....	0.03

The specimens in group No. 6 (Nos. 601 to 636) and in group No. 8 (Nos. 801 to 836) were also tested at a rate of deformation of 0.3 mm per min. The specimens Nos. 601 to 636 were loaded by means of spherical bearings whereas all other specimens were compressed between fixed parallel plates.

The testing machine was a hydraulic machine of 20-ton loading capacity. The oil was fed to the loading cylinder by a motor-driven piston pump. The rate of oil flow, which approximately determined the speed of the crosshead, was controlled by a needle valve. However, the rate of deformation appeared to be dependent not only on the amount of oil supplied to the loading system but also on magnitude of the load. Accordingly, the oil leakage valve had to be operated continuously during the tests.

The rate of deformation was checked by means of a dial gage and a stop watch (see Fig. 5). The ratio of the displacement of the crosshead to the displacement indicated by the dial gage was adjusted with the aid of a lever so that the pointer of the dial gage exactly followed the hand of the stop watch at the proper rate of deformation. To facilitate the comparison of the movements of the dial gage and the stop watch, the two dials were furnished with identical scales.

This simple setup was found to be satisfactory as long as the rate of deformation was not too low, and was

used for testing groups Nos. 1, 2, and 3 (3, 1, and 0.3 mm per min). At a lower rate of deformation (0.1 mm per min or less), the high ratio of transmission to the dial gage caused an irregularity in the movement of the pointer, with the result that the operation of the oil leakage valve became less accurate. Then a thin spring steel ring was used, and wire resistance strain gages were attached to this ring (Fig. 6). With this ring the deformation was indicated on a galvanometer scale, which was graduated in seconds and minutes, and the testing machine was operated so that the galvanometer reading followed a stop watch. In contradistinction to the mechanical gage, this electrical ring gage for measuring deformations was practically free from inertia, and the galvanometer movement was very continuous even at extremely low rates of deformation.

The dimensions of the specimens were measured before testing. After the test the specimens were weighed before and after drying in an oven at a temperature of 103 C. In this way the specific gravity (r_{ou}—oven-dry weight, volume at test) and the moisture content, u, were determined. The distribution of r_{ou} and u of 252 specimens subjected to the tests appears from Fig. 7. The mean values in the different groups are given in Table I. The prisms had 14.5 annual rings, and the autumnwood occupied 30 per cent of the cross-sectional area.

Test Results

The results of the tests are shown in Table I (mean values) and Fig. 8. Figure 8 represents the test results obtained from those six groups in which the prisms were loaded in a similar way between fixed plates, but at different rates of deformation. However, as has already been mentioned, the rate of deformation was checked by different instruments: in groups Nos. 1, 2, and 3 by a mechanical indicator (Fig. 5), and in groups Nos. 8, 4, and 5 by an electrical indicator (Fig. 6).

In Fig. 8, the straight line is the line of regression of the strength, σ, on the rate of deformation established by means of least squares. Evidently the mean values satisfy the equation:

$$\sigma = 422.5 + 33.1 (\log 100v - \log 3) \text{ kg per sq cm}$$

$$\sigma = 473 + 33.1 \log v$$

Earlier tests on Swedish fir (8) gave σ = 470 kg per sq cm for wood of specific gravity r_{ou} = 0.455 g per cu cm, and moisture content u = 13 per cent. In the above equation this corresponds to a rate of deformation v = 0.8 mm per min. However, these tests were carried out at a constant rate of loading of 120 kg per sq cm per min on specimens 5 by 5 by 20 cm in size. If the modulus of elasticity is $E = 10^5$ kg per sq cm, the rate of deformation in the elastic range was 0.24 mm per min, but was considerably higher in the plastic range preceding failure.

Accuracy of Test Results

Figure 8 shows that there is a considerable deviation in strength within the groups. This is unexpected since the prisms were very carefully selected from a comparatively short part (about three meters) of a log and from one half of the sapwood section only. The dash lines connect the values $\sigma_m \pm s$ in each group, where σ_m is the group mean strength and s is the standard deviation from the corresponding mean strength.

TABLE I.—MEAN VALUES OF COMPRESSIVE STRENGTH, SPECIFIC GRAVITY, AND MOISTURE CONTENT.

Test Specimens	Rate of Compression, mm per min	Compressive Strength, kg per sq cm	Specific Gravity, r_{ou}, g per cu cm	Moisture Content, u, per cent	Note
Nos. 101 to 136.....	3	486.2	0.447	13.10	Mechanical gage
Nos. 201 to 236.....	1	476.4	0.448	13.08	
Nos. 301 to 336.....	0.3	451.6	0.448	12.65	
Nos. 801 to 836.....	0.3	456.7	0.448	12.73	Electrical gage
Nos. 601 to 636[a].....	0.3	463.2	0.450	12.74	
Nos. 401 to 436.....	0.1	440.7	0.445	12.73	
Nos. 501 to 536.....	0.03	421.5	0.447	12.60	

[a] Spherical bearings.

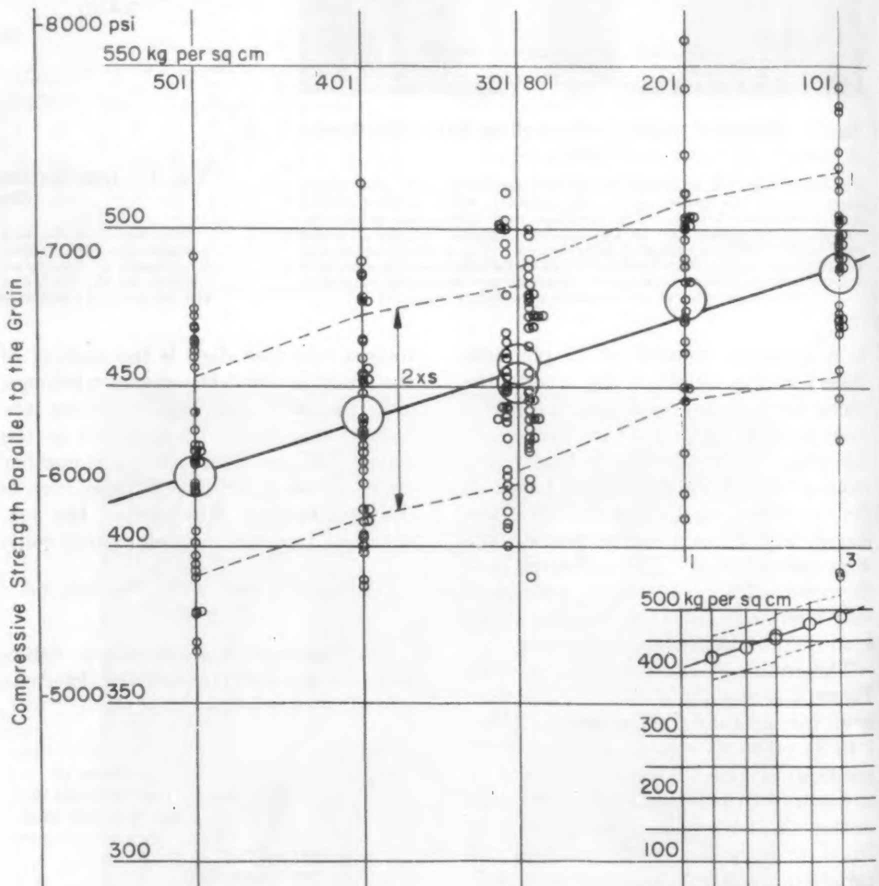

Fig. 8.—Relation Between the Compressive Strength of Fir Prisms and the Rate of Deformation in Testing.

The small circles indicate individual values, the large circles indicate group mean values. The regression line gives the strength proportional to the logarithm of the rate of deformation. When the rate of deformation is increased ten times—for example, from 0.1 mm per min to 1 mm per min—the increase in strength is 33 kg per sq cm.

The deviation of the individuals from the mean values is due mainly to variations in specific gravity of wood. However, these variations are inherent in the system of sampling and have little influence on the test results (regression line).

(The confidence limits within which 95 per cent of the individuals should lie are $\sigma_m \pm 2.02s$.)

It is generally difficult to obtain uniform wood specimens from Swedish trees, which are comparatively small.

The strength varied with the specific gravity, the moisture content, and the rate of deformation. The variation in strength is also due to load defects and to some other factors.

The distribution curves of the specific gravity and the moisture content are shown in Fig. 7. The coordinate scales are chosen assuming that a change of 4.2 in moisture percentage and a change of 0.1 g per cu cm in specific gravity cause the same change in compressive strength. At a rate of deformation of 3 mm per min, this change in strength is about 100 kg per sq cm (see Fig. 9). The value of 4.2, calculated from the present results, is about 20 per cent lower than the results of earlier Swedish tests (8). Nevertheless the moisture content distribution curve is much narrower than the density curve. Consequently, the strength variations were due to a less extent to variations in moisture content than to variations in specific gravity.

Among the wood variables, the deviation of the fibers from the main direction had probably the greatest influence on the strength, though the largest slope of the fiber direction to the longitudinal direction of the prism was 1 to 20. However, it is to be observed that the grain disturbances were generally located in certain sections of the log owing to a ring of knots in the heartwood. In view of the systematic selection of the test specimens, a comparison of the group means should therefore be almost independent of these disturbances.

The rates of deformation were fixed at five different values. Actually there were probably slight deviations from these values since it is impossible for the operator to obtain the exact loading effects, especially in the plastic range of the test. Nevertheless the comparatively high rate of deformation of 3 mm per min certainly did not deviate more than 25 per cent from the nominal value. This deviation corresponds to an error of less than 1 per cent in the strength value.

"Other factors" give the real error of the test, which is not attributable to any of the test variables. The accuracy in measuring the dimensions of the specimens is one of these other factors. No investigation was made of the standard deviation, but the maximum error in width of the specimens can be estimated at 2 per cent. This gives an error of 4 per cent in the strength.

The compressive strength of wood is generally considered to be directly proportional to the specific gravity. On this assumption, instead of strength σ, the relative strength σ/r_{ou} can be plotted against the rate of deformation. These σ/r_{ou} values are closer to the mean values than the σ values in Fig. 8. However, there still remains a relatively large deviation; further consideration would require an investigation of the influence exerted on strength by the place in the log from which the specimens were cut.

Figure 9 shows the specific gravity and the compressive strength of the prisms in group No. 1 for the specimens Nos. 101 to 136—that is, in the direction from the root to the top of the tree (see Fig. 4). There are apparent downward trends of the curve of specific gravity and the curve of strength toward the top of the tree. From these trends the influence of the specific gravity on the strength can be calculated. The interval of specific gravity, 0.40 to 0.50 g per cu cm, which comprises most of the specimens (Fig. 7), corresponds to a difference of 100 kg per sq cm in strength. A study of the deviations from these trends will also provide information on the relation between the specific gravity and the strength.

The "selective diagram" in Fig. 10 shows the location of each prism in group No. 1 in the longitudinal direction (abscissa) and in the transverse direction (ordinate). A comparison of this dia-

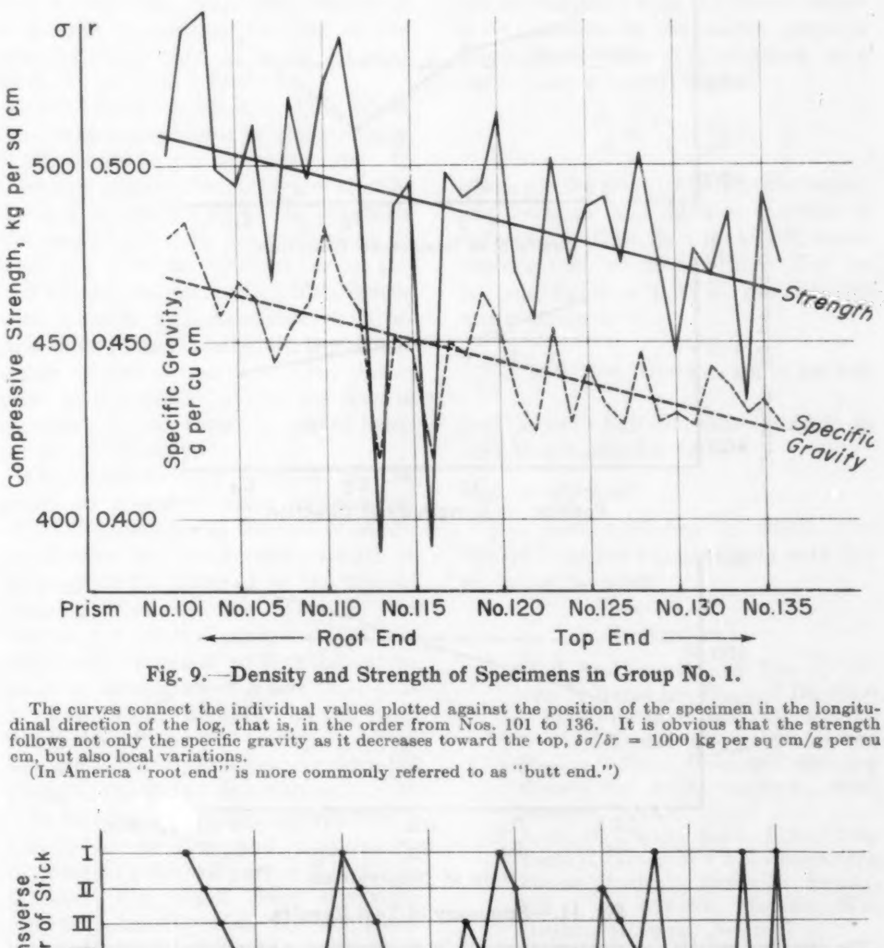

Fig. 9.—Density and Strength of Specimens in Group No. 1.

The curves connect the individual values plotted against the position of the specimen in the longitudinal direction of the log, that is, in the order from Nos. 101 to 136. It is obvious that the strength follows not only the specific gravity as it decreases toward the top, $\delta\sigma/\delta r$ = 1000 kg per sq cm/g per cu cm, but also local variations.

(In America "root end" is more commonly referred to as "butt end.")

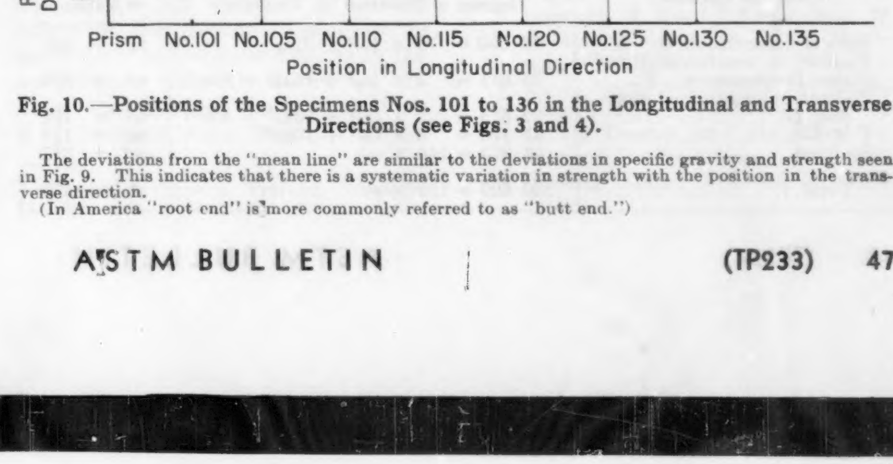

Fig. 10.—Positions of the Specimens Nos. 101 to 136 in the Longitudinal and Transverse Directions (see Figs. 3 and 4).

The deviations from the "mean line" are similar to the deviations in specific gravity and strength seen in Fig. 9. This indicates that there is a systematic variation in strength with the position in the transverse direction.

(In America "root end" is more commonly referred to as "butt end.")

gram and the diagram in Fig. 9 shows that there is a systematic distribution of the specific gravity not only in the longitudinal direction but also in the transverse direction. This will cause a deviation in individual test results, but the group means are only slightly affected owing to the system used in selecting the specimens.

Figure 11 gives the results of an analysis in which the strength is the dependent variable, while the place of the specimen in the longitudinal direction of the log, the place of the specimen in the transverse direction, and the rate of deformation are independent variables. To have symmetry, the prisms from Part 5 of the log (which contains only four prisms against eight in each of Parts 1 to 4, see Fig. 4) have not been counted, so that the analysis includes 5 × 32 = 160 specimens—the first 32 at five rates of deformation, G_1 to G_5. The four parts in the longitudinal direction of the log were denoted by L_1 to L_4, and the sticks Nos. I to VIII (Fig. 3) were referred in pairs to four positions in the transverse direction, T_1 to T_4. This gave 4 × 4 × 5 = 80 combinations and two test values (A_1 and A_2) for each combination. An analysis of the variance was then made as an incomplete four-factor analysis: three factors, G, L, and T, and one factor with replication, A.

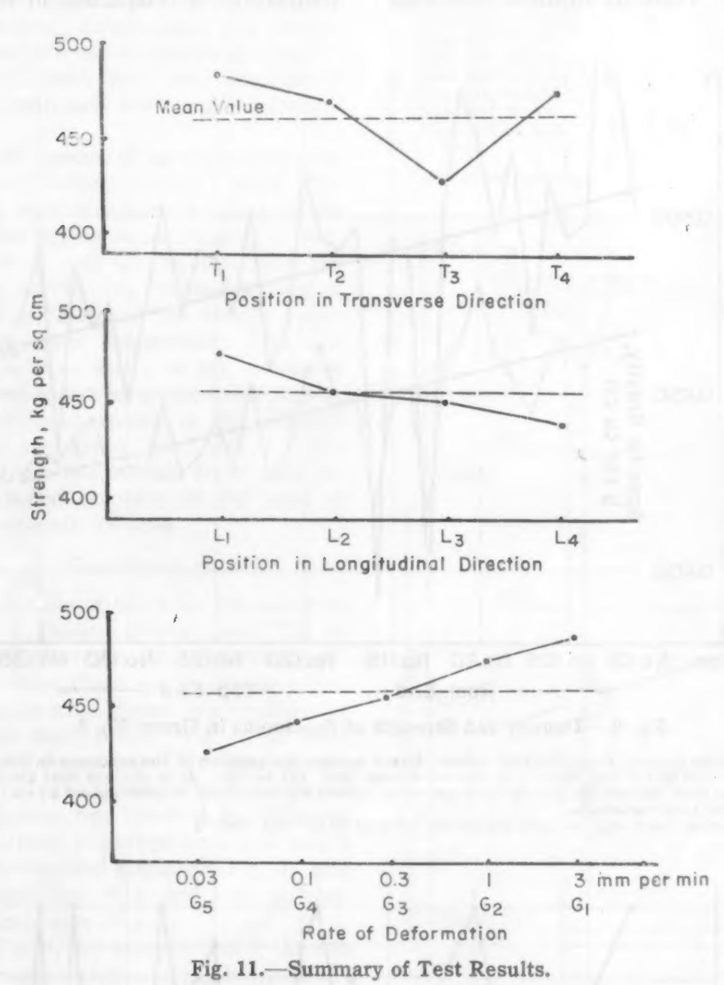

Fig. 11.—Summary of Test Results.

The dependent variable, the compressive strength (σ), is represented as a function of three independent-variables—the position in the transverse direction (T), the position in the longitudinal direction (L), and the rate of deformation (G). The horizontal dash lines mark the mean compression strength of the population σ = 458 kg per sq cm.

The first curve, which represents the strength as a function of the position in the transverse direction, shows that the wood in sector T_3 (sticks Nos. V and VI) is weaker than in the other sectors. The second curve, which represents the influence of the position in the longitudinal direction, indicates the decrease in strength toward the top, which has already been discussed. Finally, the third curve, which gives the main result of the experiments, that is, the influence of the rate of deformation on the strength, reproduces the results shown in Fig. 8.

The cause of the deviation in the individual observed values shown in Fig. 8 is illustrated in the modified analysis of the variance (see Table II). The strength of the 160 specimens dealt with in this table deviates from the mean value σ = 458 kg per sq cm so that the variance, s^2, is 1450 and the standard deviation is 38.1. The components of the variance are given in the last column of Table II. Evidently the variance due to the position in the transverse direction, s_t^2, is of the same order of magnitude as the variance due to the nominal difference in the rate of deformation, s_g^2. These two variances amount to about two thirds of the total variance (sum of squares). Compared to the variance due to the position in the transverse direction, the variance due to the position in the longitudinal direction, s_l^2, is relatively small. This indicates that a number of prisms of more uniform quality could have been selected from a narrower but longer section of the log. The variance due to the $T \times L$ interaction, $s_{lt}^2 = s_{tl}^2$, is the smallest part of the total variance. This interaction was probably caused by the grain deviation at some levels of the tree. Finally, concerning the residual variance s_0^2, which is unattributable to G, T, L, or $T \times L$, it is to be observed that this term is also influenced by the systematical variation of strength in the longitudinal and transverse directions.

TABLE II.—MODIFIED TABLE OF VARIANCE.

Cause of Variation	Sum of Squares = Degrees of Freedom × Variance	Component of Variance
Rate of deformation, G	76 600 = 4 × $(s_0^2 + 32s_g^2)$	s_g^2 = 589
Position in transverse direction (cross-section), T	73 611 = 3 × $(s_0^2 + 10s_{tl}^2 + 40s_t^2)$	s_t^2 = 576
Position in longitudinal direction, L	22 619 = 3 × $(s_0^2 + 10s_{lt}^2 + 40s_l^2)$	s_l^2 = 151
$T \times L$	13 326 = 9 × $(s_0^2 + 10s_{lt}^2)$	s_{lt}^2 = 116
Residual	44 373 = 140 × s_0^2	s_0^2 = 317
Total	230 529 = 159 × s^2	s^2 = 1450

Limits and Applicability of Test Results

As has already been mentioned, the purpose of this investigation was to determine an appropriate rate of deformation in testing small clear specimens of wood in compression in a special testing machine. Strictly speaking, the applicability of the results is limited to wood specimens of the same kind loaded in the same way as in this investigation, but in practice the results can probably also be of value as a basis for the choice of the testing speed under somewhat different conditions.

Species of wood other than Swedish fir

may react in a different way to the rate of deformation. Probably (but not necessarily) the strength of wood having a large range of plasticity in its stress-strain curve (often a low ratio of the proportional limit stress to the ultimate stress) will vary with the rate of deformation to a greater extent than the strength of more elastic wood.

There seems to be little reason to expect the influence of the rate of deformation on the strength to be dependent on the cross-sectional area. But the variation in strength with the length of the specimen is no doubt not to be neglected. One opinion, of which the United States and British specifications[3] for compression tests are an expression, is that a constant rate of strain is preferable to a constant speed of machine head. As long as the test specimen is thoroughly homogeneous, this is obviously correct. In ordinary wood, however, especially at high stresses, the main part of the deformation is likely to take place in one or a few weak parts of the specimen. Then the use of a constant rate of strain referred to the whole length is perhaps not more correct than the use of a constant rate of deformation. Further investigation of this problem is desirable.

The First Conference on Mechanical Wood Technology of F.A.O.[2] recommended that the test be carried out during a time of not less than 2 min and not more than 5 min. In compression tests of prisms 75 mm in height, this corresponds to a rate of deformation from 0.1 to 0.3 mm per min. The ASTM methods[3] recommend a rate of straining of 0.003 ± 0.0006 per min. In the 3-in. prisms this corresponds to a rate of deformation of $0.003 \times 3 \times 25.4 = 0.23$ mm per min. Consequently, if the rate of deformation in testing specimens 75 mm in height is fixed at 0.25 ± 0.05 mm per min, this will be in accordance with the F.A.O. and ASTM recommendations. The tolerance of about ± 1 per cent in strength makes it easier to use different types of testing machines

In several European countries, a *constant rate of loading* is recommended instead of a constant rate of deformation for standard tests, such as compression and tension tests. Below the proportional limit the rate of deformation will then also be constant, although it will usually increase to very high values in the range of plastic deformation. One advantage of constant rate of loading is the fact that a definable and usually simple relation exists between the observed load or force and the stress in the test specimen. A definite relation between the movement of the testing machine head and the actual strain on the specimen is not usual, since the elastic and the permanent deformations in the bearing and at the ends of the specimen result in differences between the gross deformation, which is caused by the movement of the head of the testing machine, and the deformation within that part of the specimen in which failure occurs. This error cannot be eliminated unless the testing speed can be controlled by the last-mentioned deformation. The most serious disadvantage of testing plastic materials at a constant rate of loading is that the determination of the ultimate load is very often subjective, because it is difficult to continue the test at the predetermined rate of load increase while the material is flowing.

The German specification[4] DIN 52185 recommends a constant rate of stressing of 200 to 300 kg per sq cm per min. If the mean value of the modulus of elasticity is $E = 100{,}000$ kg per sq cm, then the rate of strain in the early stage of loading is 0.002 to 0.003 cm per cm per min (in. per in. per min). This agrees with English and American practice. Above the proportional limit, the rate of strain increases owing to the plastic yield of the wood. When the flow is considerable, the constant rate of loading is quite illusory.

Compression tests parallel to the grain do not give much information about the influence of the rate of strain or stress on the compressive strength at an angle to the fibers or on the tensile, shearing, and bending strength. In tension the plastic component of the deformation is small, so that the importance of testing speed is less than it is in compression. In shear, on the other hand, the influence of testing speed on the strength is probably considerable owing to the plastic deformation.

In bending, the plastic deformation is mainly due to shear and compression, whereas only a small part of it is due to tension. The small clear specimens for static bending tests are commonly rather long in comparison with their cross-section, so that only compression produces a great plastic strain, especially when the beam is loaded at the one-third points. In static bending, either the rate of loading or the rate of deflection can be kept constant. The difficulties of the constant-rate-of-loading method are of the same kind as in the compression test. It should be observed that although the bending stress is by definition proportional to the load, $\sigma = M/W$, where M is the bending moment and W is the moment of resistance, the real compressive and tensile stresses are not proportional to the load as soon as a plastic deformation occurs and are difficult to calculate because Hooke's law is no longer applicable. In compression tests or tension tests, the strain is derived from the force in the same way, regardless of whether it is in the elastic or the plastic range. At plastic deformation in bending, only the mean value of the strain on the compressed side of the beam and the strain on the tensioned side can be calculated directly from the deflection (the cross-sections must be assumed to remain plane, without warping).

Of course, the rate of strain in bending can be compared with the rate of strain in compression in the elastic range of deformation. The rate of strain in a beam under a central load is:

$$\frac{d\epsilon}{dt} = \frac{6h}{l^2} \times \frac{dy}{dt}$$

where ϵ is the strain, h is depth of beam, l is the span, and dy/dt is the rate of deflection. Thus, in the ASTM static bending test, where $h = 1$ in., $l = 14$ in., and $dy/dt = 0.05$ in. per min, the rate of strain is

$$\frac{6 \times 1}{14^2} \times 0.05 = 0.0015 \text{ in. per in. per min}$$

that is, only half the rate of strain in ASTM compression tests.

Acknowledgment:

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Plastics Testing at High and Low Temperatures

By C. H. Klute and L. B. McKee

The authors describe equipment used to conduct a variety of mechanical tests on a 60,000-lb universal testing machine in the −70 to +500 F range, and a low-temperature impact tester, usable from room temperature to −70 F.

In the course of the routine evaluation of organic plastics, synthetic adhesives, and the like, it is frequently required to measure a variety of strength properties over a range of temperatures extending from −70 to +500 F. The problem of performing these tests amounts to that of providing satisfactory enclosures about the sample position within which the desired temperature conditions may be maintained. A satisfactory enclosure may be defined for this purpose as one that provides a reasonably uniform temperature without encumbering the test apparatus unduly. The enclosures described herein are rather finalized designs that have evolved from more rudimentary arrangements over a considerable period. While they represent the most satisfactory arrangements encountered to date, they are not necessarily the best which continued effort could produce, but inasmuch as testing over a wide range of temperatures is more and more frequently required, these temperature control systems may be of sufficient interest to warrant at least a brief description at this time.

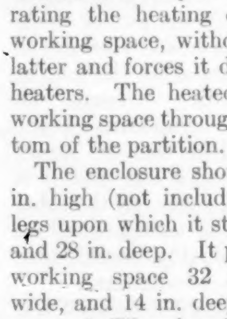
High-Temperature Testing on a 60,000-Lb Universal Testing Machine

Figure 1 shows the general arrangement employed to accomplish the tensile and flexural testing of plastic laminates and synthetic adhesive-metal sandwiches above room temperature. The enclosure consists of a large insulated box with a chamber in the rear in which the heating elements are contained. A 100-cu-ft-per-min blower, located at the top of the partition separating the heating chamber from the working space, withdraws air from the latter and forces it downward over the heaters. The heated air re-enters the working space through a vent in the bottom of the partition.

The enclosure shown in Fig. 1 is 40 in. high (not including the removable legs upon which it stands), 24 in. wide, and 28 in. deep. It provides an interior working space 32 in. high, 16 in. wide, and 14 in. deep. A 4-in. thickness of Fiberglas insulation is used between the inner and outer walls. To reduce the loss of heat due to the opening and closing of the door during testing, the door is constructed in two separately hinged halves. Many minor manipulations may be made by opening only the lower half, and thereby a large measure of the hot air that would otherwise be lost is conserved.

Whenever tension forces are required, the box is installed between the upper and the moving crossarms of the tester. This requires that the box be supported on four steel legs resting on the bottom platen of the tester. When the testing conditions require the application of compression forces of fairly high order, it is more satisfactory to locate the box between the bottom platen and the moving crosshead. This is conveniently accomplished by running the moving crosshead to the top of its travel and resting the box minus its legs on the bottom platen.

The box is heavy and cannot be conveniently lifted by two men unaided. Accordingly, all movements of the box



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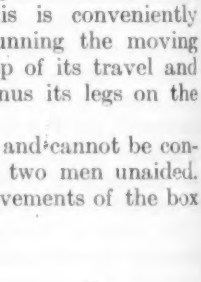

LEONARD B. McKEE, Shell Development Co., Emeryville, Calif., has since 1947 been concerned with development and application of testing equipment for physical evaluation of high polymer systems.

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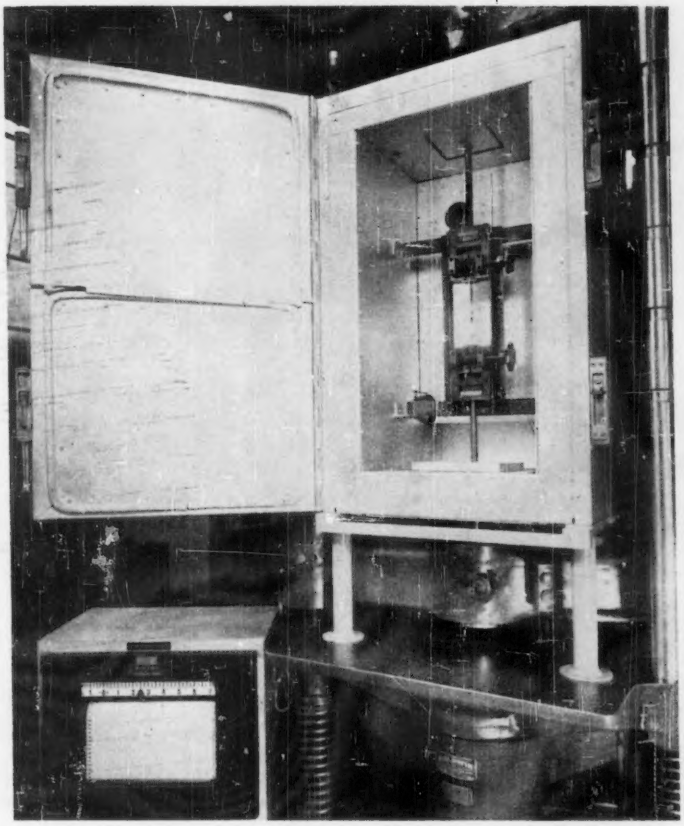


Fig. 1.—High-Temperature Enclosure for Plastics Testing.

are performed by means of a chain hoist which travels on an I-beam anchored to the ceiling. When the box is removed from the tester, it is lowered onto a dolly especially provided for it and wheeled out of the way.

In view of the very high temperatures involved, careful consideration had to be given to the test fixtures. To make the setup as flexible as possible, removable insulated plugs have been provided top and bottom so that a wide variety of fixtures may be inserted into the heated enclosure. For testing the strength properties of sheet plastics in tension (ASTM Method D 638)[1] and the strength properties of adhesives in shear by tension loading (metal-to-metal) (ASTM Method D 1002),[2] special wedge type grips have been constructed. A view of these grips installed in the high temperature chamber appears in Fig. 1. A detail of the grips appears in Fig. 2. They are each arranged to slide along a prealigned track which offers only horizontal constraints to their motion. The wedges of each grip are geared together through individual racks running on a common pinion and are kept in continual contact with the body of the grip by pins on the wedges which run in slots on the body. These grips are also constructed with a full back integral with the body, and sufficient strength is provided thereby so that the front of the grip can be left substantially open.

This design offers a number of advantages. For example, the wedges will not fall out of position when the load is released, the specimen can be inserted from the side instead of from the end of the grip, and the wedges can be closed rapidly and accurately. The track insures that the two grips will be correctly positioned with respect to each other to receive the specimen. The importance of speed and convenience of manipulation in view of the extremely high temperatures used can scarcely be overemphasized. On occasions testing is done at 600 F, and at this temperature elaborate precautions must be observed to protect the operator against burns. It develops that the only solution to the problem is multilayered insulating gloves and a set-up where rapid manipulation is possible. With conventional self-aligning grips, this is impossible.

To preserve some of the advantages of self-aligning grips, shims are provided to offset one grip $\frac{1}{16}$ in. with respect to the other for the adhesive tensile shear test. This offset is removed by placing the shims on the same side of each grip. This is recognized as a compromise procedure. To prevent undue heat loss through the shanks, they are not connected directly to the grips but act on the grip bodies through an insulating bushing which sustains the load in compression. This is not, of course, completely effective, but it is a help.

A very similar arrangement has also been constructed for flexural tests. The high-temperature enclosure is installed in the same position as for tension testing, and the tension loads applied to the specimen through steel yokes which strain the specimen in flexure. Such a configuration allows one to measure the deflection of the specimen by assuming that this is equal to the travel of the platen relative to the lower crossarm. In view of the rigidity of the steel fixture and the light loads sustained by the specimen in flexure, this is a reliable assumption. Accordingly, the deflectometer is set on the platen to transmit the deflection to the recorder. This is the only set-up to date in which extensometers have been used in high-tempera-

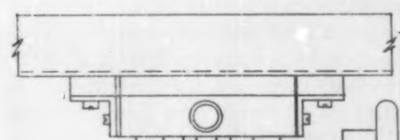


Fig. 2.—Tension Test Grips for Tests on Plastics and Adhesives at High Temperatures.

[1] Tentative Method of Test for Tensile Properties of Plastics (D 638 – 52 T), 1952 Book of ASTM Standards, Part 6, p. 655.

[2] Tentative Method of Test for Strength Properties of Adhesives in Shear by Tension Loading (Metal-to-Metal) (D 1002 – 53 T), 1953 Supplement to Book of ASTM Standards, Part 7, p. 225.

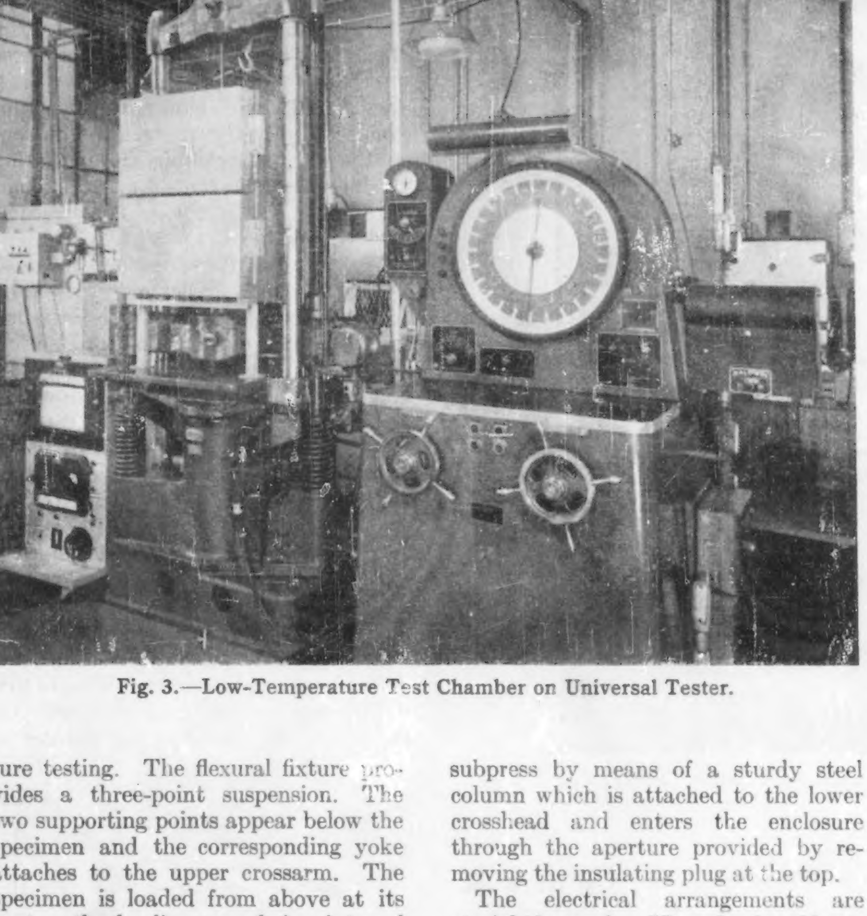


Fig. 3.—Low-Temperature Test Chamber on Universal Tester.

ture testing. The flexural fixture provides a three-point suspension. The two supporting points appear below the specimen and the corresponding yoke attaches to the upper crossarm. The specimen is loaded from above at its center, the loading nose being integral with a yoke attaching to the lower crossarm. Both yokes move in a vertical track fixed to the interior of the high-temperature enclosure.

In conducting compression tests, loads of several thousand pounds are generally delivered to the specimen. Shell Development Co. is presently testing according to Federal Specification LP406b, Method 1021, as amended by the Military Specification MIL-R-7575 (USAF), paragraph 4.3.2.1.1, in which a supporting fixture is attached to the specimen and the load applied parallel to the long dimension of the specimen. In view of the high loads, the following arrangement is used. The legs are removed from the high-temperature enclosure, and it is set upon the lower platen of the tester with the false bottom removed. In its place a large plug of rigid insulating material (Marinite-A),[3] which is faced top and bottom with ¼-in. steel plate, is placed directly upon the platen of the tester. The compression subpress is placed at the top center of the Marinite plug and the specimen and fixture installed beneath its ram. The test load is applied to the subpress by means of a sturdy steel column which is attached to the lower crosshead and enters the enclosure through the aperture provided by removing the insulating plug at the top.

The electrical arrangements are straightforward. Three banks of heaters are provided within the heating section. Each bank provides a maximum of 1500 w of heat. One bank which supplies the continuous heat is continuously adjustable by means of an autotransformer. Another bank is provided with a high and low switch so that in the low position its power is reduced to 750 w. This bank of heaters is energized by a Brown Electronik temperature controller-recorder whenever the temperature drops below the control point. The third bank of heaters, also provided with a high and low switch, is energized by a Micromax indicating controller whenever the oven temperature falls 15 or 20 F below the control point, for instance, when the doors are opened. This extra heat helps the system return to the operating temperature rapidly after manipulations between tests have been made.

Due to the temperatures involved, no copper wire can be used in the enclosure. Stainless steel wire with asbestos and glass fiber insulation was used throughout. Likewise the various lugs and the heater shells were of stainless steel.

Low-Temperature Testing on a 60,000-lb Universal Testing Machine

A very similar arrangement has been developed for use at temperatures from room temperature to −70 F. In this case a somewhat smaller enclosure is provided. Of itself, it incorporates no heating or cooling equipment since it is

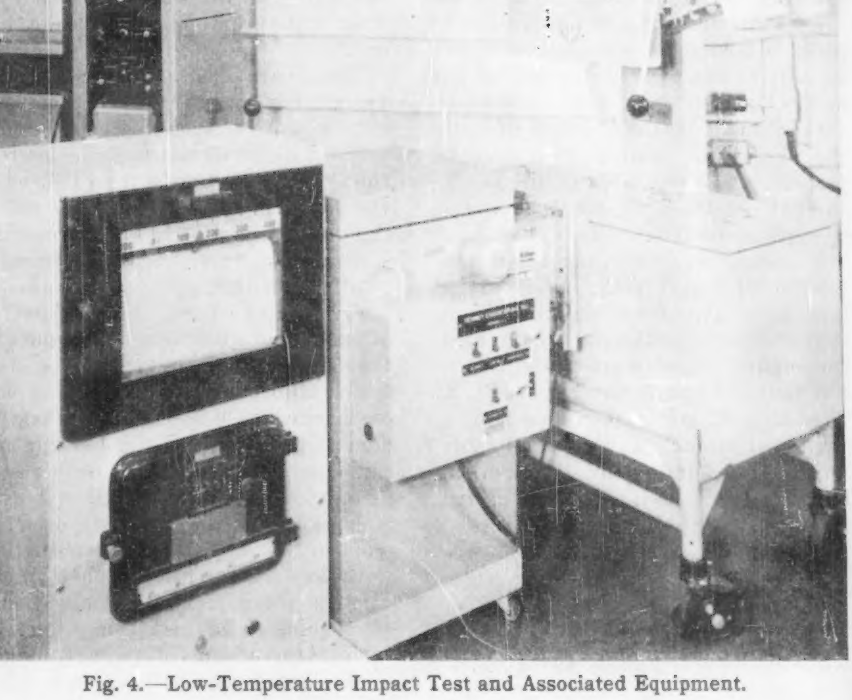


Fig. 4.—Low-Temperature Impact Test and Associated Equipment.

[3] A product of the Johns-Manville Corp., Manville, N. J.

supplied with air at the desired temperature by a Tenney TSU-150 air servo unit[4] which has been modified to be controlled by the Brown controller. Fixtures and arrangements identical to those in high-temperature testing are provided. Polystyrene foam insulation is used.

The general arrangement appears in Fig. 3. The same fixtures and temperature control unit previously described are used with the low-temperature enclosure, and except for the difference in temperature range, all arrangements are the same as in the previous case.

Low-Temperature Impact Test:

Figure 4 shows the arrangement used in these laboratories for low-temperature impact and impact-shear testing. This apparatus is built around a standard model impact tester furnished in the 60 ft-lb capacity with modified striker and anvil fixture to take the standard impact-shear specimen as specified in ASTM Method D 950.[5] The base of the tester is secured to a heavy frame of welded steel construction. Large casters are provided to give the tester a measure of portability; these are of the variety that may be locked in place once the tester is located. The base of the tester is enclosed in a trough insulated with polystyrene foam. Generally the base is precooled to the temperature of test with dry ice, after which the temperature is maintained by air delivered to the trough by the air servo unit. The temperature control unit, similar to that previously described, employs the indicating controller to govern the air temperature and the temperature recorder to record the specimen temperature.

[4] A product of the Tenney Engineering Co., Newark, N. J.

[5] Tentative Method of Test for Impact Strength of Adhesives (D 950 – 52 T), 1952 Book of ASTM Standards, Part 7, p. 1024.

Impact tests are performed by cooling the specimens to the test temperature in the trough. After a specimen reaches temperature equilibrium, the air circulation is interrupted, the trough covers are carefully removed, and the striker is immediately tripped. A new specimen is at once inserted and the cycle is repeated. The apparatus has been used successfully at temperatures as low as −70 F.

Temperature Conditions Within the High-Temperature Enclosure

The temperature distribution within the high-temperature enclosure was measured in a manner similar to that prescribed by ASTM Method D 1197.[6] The temperatures were determined at nine points within the interior of the working chamber by means of iron-constantan thermocouples connected to a ten-point Micromax. The thermocouples were located at each of eight corners $2\frac{1}{2}$ in. from the walls and 5 in. from the top or bottom. One thermocouple was also located in the air at the center of the chamber, and close to it was another, fastened to a tensile shear specimen held in the grips. The results are given in Table I.

The "temperature fluctuation" indicates the temperature difference corresponding to the highest and the lowest temperatures recorded as a function of time. The air temperature fluctuation was given by the control thermocouple located at the center of the chamber. The "temperature differential" corresponds to the temperature difference between the hottest and the coldest points within the chamber recorded during a short time interval. The nominal Fahrenheit operating temperatures have been converted to Centigrade temperatures to permit direct comparison with the requirements of ASTM Method D 1197. It is apparent that below 300 F the high-temperature enclosure complies with the requirements for a Grade B unit as defined by the specification cited above. Above this temperature the increasing point-to-point variation in temperature is outside the stipulated limits. In view of the very considerable difficulties residing in the problem of operating such a high-temperature enclosure in conjunction with a large testing machine, this performance is satisfactory in the opinion of the authors. Doubtless more elaborate arrangements could do better.

[6] Tentative Specification for Enclosures and Servicing Units for Tests Above and Below Room Temperature (D 1197 – 52 T), 1952 Book of ASTM Standards, Part 6, p. 1381.

TABLE III.—RECOVERY TIMES.

Temperature, deg Fahr	Recovery Time, min
−70	3.9
+180	2.0
+250	3.1
+300	3.1
+500	3.8

Temperature Conditions Within the Low-Temperature Enclosure

The corresponding data for the low-temperature enclosure are given in Table II.

In this equipment, the cooling is supplied by circulating the air alternately through dry ice and over a bank of heaters. This is accomplished in the air servo unit by means of a motor-controlled damper which sends the air delivered to the enclosure through either path. The damper action does not proportion the air flow through the heating or cooling path but rather supplies either warm or cold air depending upon whether the enclosure is below or above the control temperature. Such an arrangement has mechanical simplicity as its chief virtue. A 3-ft section of insulated dual duct connected between the low-temperature chamber and the air servo unit provides a certain amount of mixing of the alternate "parcels" of air before the air stream is discharged into the chamber. Since there is a minimum of insulation between the inlet and outlet sections of the duct, it operates to a certain extent as a heat exchanger, tempering the air delivered by the air servo unit. The entering air impinges upon a baffle plate immediately upon entering the test chamber to complete the mixing at that point. Since thermocouples were placed in parts of the chamber near the points of entry and exit of the circulated air, the temperature differential gives in effect the difference between the effective air temperature of the incoming and outgoing air. The temperature cycles in the test area are very fast, and the inability of the specimen

TABLE I.—TEMPERATURE CONDITIONS WITHIN THE HIGH-TEMPERATURE ENCLOSURE.

Nominal Operating Temperature	Air Temperature, deg Cent	Air Temperature Fluctuation, deg Cent	Air Temperature Differential, deg Cent	Specimen Temperature, deg Cent	Sample Temperature Fluctuation, deg Cent
93 C (200 F)	93	1	2	93	<1
149 C (300 F)	149	2	3	149	2
204 C (400 F)	204	2	13	200	2
260 C (500 F)	260	2	14	257	2

TABLE II.—TEMPERATURE CONDITIONS WITHIN THE LOW-TEMPERATURE ENCLOSURE.

Nominal Operating Temperature	Air Temperature, deg Cent	Air Temperature Fluctuation, deg Cent	Air Temperature Differential, deg Cent	Specimen Temperature, deg Cent	Specimen Temperature Fluctuation, deg Cent
−31 C (−24 F)	−31	2	3	−31	<1
−41 C (−42 F)	−41	2	3	−41	<1
−58 C (−73 F)	−58	1	4	−58	<1

TABLE IV.—COMPARISON OF DATA OBTAINED WITH HIGH- AND LOW-TEMPERATURE (PREALIGNED) GRIPS WITH THAT OBTAINED WITH STANDARD SELF-ALIGNING GRIPS.

Type of Grip Used	Number of Tests	Average	t Test	Variance	Degrees of Freedom	Variance Ratio
High- and low-temperature grips....	20	3640	1.72[a]	40 910	19	...
Self-aligning grips....	20	3528	...	43 220	19	1.05[b]

[a] Not significant at the 5 per cent level.
[b] Highly insignificant.

TABLE V.—FLEXURAL STRENGTH OF EPON-GLASS CLOTH LAMINATE AT HIGH TEMPERATURES.

Test Temperature	Specimen	Flexural Strength, psi		
		Sample I	Sample II	Sample III
+77 F (room temperature)	No. 1........	73 100	65 000	86 900
	No. 2........	65 100	65 800	85 500
	No. 3........	69 700	66 100	88 200
	Average......	69 300	65 600	86 900
+300 F	No. 1........	45 200	48 400	54 600
	No. 2........	57 500	49 900	52 100
	No. 3........	58 600	49 700	48 800
	Average......	53 800	49 300	51 800
+500 F	No. 1........	37 000	38 100	51 400
	No. 2........	37 500	48 000	51 600
	No. 3........	37 500	44 300	43 700
	Average......	37 300	43 500	48 900

TABLE VI.—ANALYSIS OF VARIANCE OF FLEXURAL STRENGTHS.

Source of Variance	Degrees of Freedom	Sum of Squares	Mean Squares	Variance Ratio
Temperature.........	2	4530	2265	73[a]
Samples.............	2	576	288	9.3[b]
Residual............	22	684	31	...
Total...............	26	5790	...	...

[a] Highly significant.
[b] Significant at the 1 per cent level.

TABLE VII.—COMPARISON OF VARIANCES OF FLEXURAL STRENGTHS AT HIGH TEMPERATURE TO VARIANCE AT ROOM TEMPERATURE.

Test Temperature	Variance Within Samples	Degrees of Freedom	Variance Ratio (Compared to Room Temperature)
+77 F (room temperature)..........	6 100	6	...
+300 F...............	21 700	6	3.6[a]
+500 F...............	15 300	6	2.5[a]

[a] Not significant at the 5 per cent level.

TABLE VIII.—DECREASE IN TENSILE SHEAR STRENGTH OF EPON-BASED ADHESIVE WITH INCREASE IN TESTING TEMPERATURE.

Test Temperature	Specimen	Tensile Shear Strength, psi		
		Batch 607-13	Batch 607-15	Batch 607-18
−70 F	No. 1.......	2340	2120	...
	No. 2.......	2370	2190	...
	No. 3.......	2600	2370	...
	Average.....	2440	2230	...
+77 F (room temperature)	No. 1.......	2310	1970	2330
	No. 2.......	2400	1930	2260
	No. 3.......	2200	2030	2310
	Average.....	2300	1980	2300
+400 F	No. 1.......	2280	...	1950
	No. 2.......	2150	...	1950
	No. 3.......	2060	...	2180
	Average.....	2160	...	2030
+500 F	No. 1.......	1780	1900	1640
	No. 2.......	1750	1730	1630
	No. 3.......	1820	1690	1630
	Average.....	1780	1770	1630

TABLE IX.—ANALYSIS OF VARIANCE OF TENSILE SHEAR STRENGTHS.

Test Temperature (Compared to Room Temperature)	Source of Variance	Degrees of Freedom	Sum of Squares	Mean Squares	Variance Ratio
−70 F	Temperature...	1	110 208	110 208	9.1[a]
	Batches.......	1	216 008	216 008	17.8[b]
	Residual......	9	109 076	12 120	...
	Total.........	11	435 292	...	...
+400 F	Temperature...	1	128 136	128 136	12.0[b]
	Batches.......	1	14 700	14 700	1.4
	Residual......	9	95 732	10 636	...
	Total.........	11	...	...	...
+500 F	Temperature...	1	966 048	966 048	61.0[b]
	Batches.......	2	85 232	42 616	2.6
	Residual......	14	223 368	15 956	...
	Total.........	17	...	...	...

[a] Significant at the 5 per cent level.
[b] Significant at the 1 per cent level.

TABLE X.—COMPARISON OF VARIANCES OF TENSILE SHEAR STRENGTHS AT HIGH AND LOW TEMPERATURES TO VARIANCE AT ROOM TEMPERATURE.

Test Temperature	Variance	Degrees of Freedom	Variance Ratio (Compared to Room Temperature)
−70 F...............	18 432	4	4.0[a]
+77 F (room temperature)...........	4 624	6	...
+400 F...............	14 932	4	3.2[a]
+500 F...............	4 568	6	1.0[a]

[a] Not significant at the 5 per cent level.

to follow them accounts for the small fluctuation of the specimen temperature.

Recovery Time

Table III gives the time required for the equipment to return to the testing temperature after the doors have been opened, the specimens exchanged, and the door closed. The tensile shear test for adhesives was taken as a typical case.

Variability of Test Values

In view of the fact that the tensile shear fixture uses a prealigned type of grip which differs from the conventional self-aligning type, it was advisable to determine the effect of this change upon the test results. Accordingly 40 tensile shear specimens, as nearly identical as possible, were randomized, and 20 of them were tested at room temperature in the arrangement described above. The balance were tested with standard self-aligning grips. It is apparent from the data in Table IV that insofar as this analysis shows the change in design of the grips has introduced no new variable into the test.

To indicate the effectiveness of the equipment just described, data are presented from routine tests of epon-glass cloth laminates and epon-based adhesives. While the amount of data is limited, it will serve to indicate the magnitude of the testing variance relative to that of the effects investigated in addition to showing that the test variance is not significantly different at extremes of temperature from the test variance at room temperature.

The magnitude of the testing variance is shown by a group of flexural strengths of a glass cloth laminate determined at 77 (room temperature), 300 and 500 F. In this experiment a large laminate was prepared, and three small samples were removed from it at widely separated positions. Each sample produced nine flexural specimens which, when randomized, were tested, three at a temperature. The original problem had been to ascertain whether or not the measured properties of the laminate were equivalent at each position. The flexural strengths as they were determined are shown in Table V. Table VI gives the results of an analysis of variance of these data. In this analysis it has been assumed that the total variance is the sum of variances due to the different temperatures of test, the difference between samples, and a residual variance representing the inherent variability of the test data within the samples at any one temperature. Comparison of the first two variances with the last one indicates that the properties vary significantly with temperature as well as from sample to sample. The first conclusion is of course obvious from the inspection of the data, and the second conclusion, while not obvious, confirmed other experience. This experiment demonstrates that the testing variability is (in this case at least) significantly smaller than the effects measured. The analysis is completed by comparing the average variance within the sets of three at 300 and 500 F, respectively, with the corresponding variance at room temperature. The variance ratios so obtained in Table VII indicate that the average variances are not significantly greater at the high temperatures than at room temperature.

A second example of the equipment's effectiveness is drawn from a series of tensile shear strength determinations made upon three supposedly identical batches of adhesive. The original problem had been to show that the three production batches were identical for all practical purposes. Strength determinations were made at −70, +77 (room temperature), 400, and 500 F. Since the aliquots of two batches submitted were insufficient to make the requisite twelve specimens, it was arbitrarily decided not to test one batch at −70 F and not to test the other at 400 F. Accordingly, it was necessary to conduct the analysis by comparing the variances at above and below room temperature to that at room temperature. The original data appear in Table VIII, and the results of the analysis of variance in Table IX. Again the obvious conclusion that the strength of all batches undergoes highly significant changes as the temperature is varied appears directly. Only in the case of the tests at −70 F does any significant difference between batches appear. In Table X is given a comparison of the average variance within the sets of three specimens at −70, 400, and 500 F with the corresponding variance at room temperature. In no case examined is the test variance at above and below room temperature significantly greater than it is at room temperature.

Conclusion

It is recognized that these tests are not exhaustive, but they do serve to show that, despite the mechanical complexity of the apparatus described, the test functions satisfactorily. The impact tester described has been used only in a very limited number of instances and then for very special tests, so that comparable data on the precision of this equipment are not yet available.

Acknowledgment:

The authors wish to express their appreciation to R. S. Orrfelt for his valuable contributions to the design and construction of the apparatus described, and to G. G. Eldredge for helpful discussions.

Need for a Standardized Procedure for Measuring Reflectance of Detergency Fabrics[1]

By R. B. Diaz, H. Paitchel, and J. A. Woodhead

The authors point out some of the factors which can change reflectance measurements of fabrics. These effects can be the source of confusion where interlaboratory studies are concerned.

THE most popular method of interpreting detergency is in terms of the reflectance of the washed cloth. This is measured on any suitable photometer, usually expressed as the per cent reflectance relative to that of a freshly prepared surface of magnesium oxide. Where neutral, gray soils are present and fluorescent brighteners are absent, this type of measurement correlates with visual preference of whiteness. Such instruments as the Hunter Multipurpose Reflectometer, Photovolt Reflection Meter, Color Eye, Hunter Color and Color Difference Meter, and the spectrophotometer have been used to measure this property. These readings are generally made with a green tristimulus (Y value) filter, or on a spectrophotometer using the 550 mμ wavelength.

The purpose of this paper is to acquaint the reader with some of the factors that influence the reflectance values. These factors can, on occasion, lead to erroneous results, particularly where group efforts are concerned, such as investigation by various laboratories of basic detergency problems. Failure to give detailed instructions on reflectance measurements can result in lack of agreement. It is essential, therefore, that those in the field evaluating detergents be concerned with establishing a standard technique for measuring fabric reflectance.

A list of the various factors that can influence reflectance measurements would be quite extensive and would entail a study of each type of instrument. There are some considerations, however, that are common to most commercially available devices. Therefore, it is proposed at this time to discuss the effects of specimen positioning, background, fluorescence, and poor mechanical alignment of the optical system. This investigation has been confined to the Hunter Multipurpose Reflectometer and the Hunter Color and Color Difference Meter in the reading of Indianhead muslin. Although these factors may not all occur to the same degree, their existence in other instruments appears very probable.

Effect of Fabric Positioning

Differences in reflectance will occur when the weave of the cloth is oriented in different positions on the exposure head. A typical discrepancy of two units is illustrated in Table I when the cloth is rotated 90 deg. The cause of this phenomenon can be ascribed to variation in light-scattering qualities from a fixed light source due to the different surface structure in the warp and filling directions. To overcome this difference, a fixed orientation should be prescribed.

TABLE I.—EFFECT OF FABRIC POSITIONING.[a]

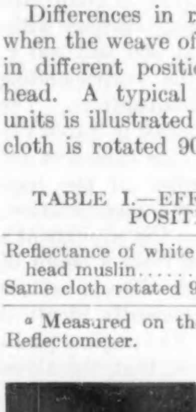
Reflectance of white Indianhead muslin..............	67.8 per cent
Same cloth rotated 90 deg..	65.6 per cent

[a] Measured on the Hunter Multipurpose Reflectometer.

Effect of Background

Perhaps the greatest source of deviation between laboratories is due to the manner in which the cloth is backed up on the exposure head. Figure 1 shows how the reflectance of a white cloth increases when backed up with additional cloths of the same whiteness. In the case of the black backing, it appears that seven additional cloths are required to reach the maximum value. When backed up with the high reflecting standard, fewer cloth backgrounds are required to obtain maximum reflectance. With the gray soiled cloth in Fig. 1, this effect is small, only one additional soiled cloth being required to reach maximum reflectance.

The same increase in reflectance occurs when a single piece of this same cloth, unsoiled, is backed up with different reflectance standards (Fig. 2). The reason for this increase in reflectance is



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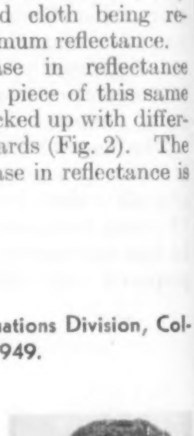
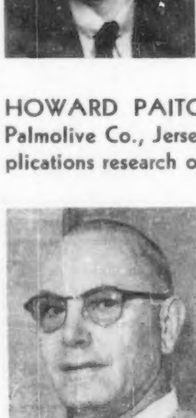


HOWARD PAITCHEL, Research and Development, Colgate-Palmolive Co., Jersey City, N. J., has a broad background in applications research on detergents and related products.



J. A. WOODHEAD, for 19 years in charge of Evaluation Division, Colgate-Palmolive Co., Jersey City, N. J., has served in the ASTM Textile Committee and in D-12 on Soaps and Detergents in which he has been chairman of Physical Test Subcommittee for 8 years.

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[1] Presented at a meeting of the ASTM Committee D-12 on Soaps and Other Detergents, New York, N. Y., March 23, 1954.

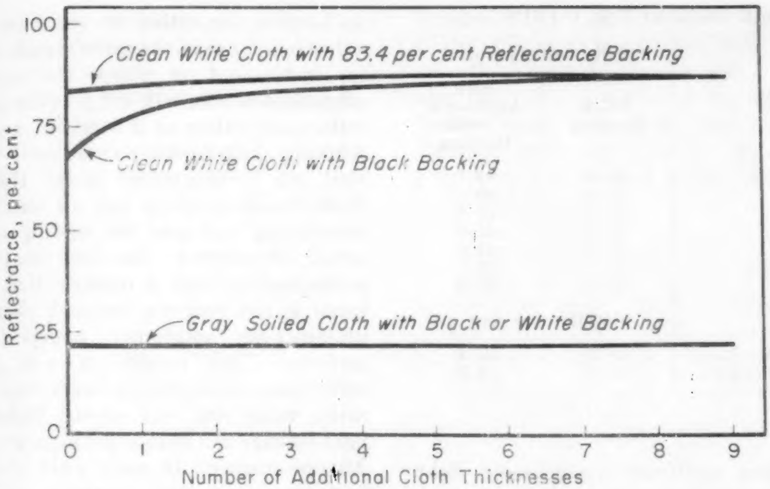

Fig. 1.—Effect of Additional Cloth Background on Reflectance.

TABLE II.—EFFECT OF BACKGROUND ON REFLECTANCE, PER CENT.[a]

Reflectance of, Background	0.52% Black	84.7% White
Swatch No. 1	68.3	86.4
Swatch No. 2	67.0	86.5

[a] Single fabric measured on Hunter Multipurpose Reflectometer.

probably due to partial transmission of light through the fabric. Cotton is not completely opaque; some of the light impinging on the surface will be transmitted through the cloth. If cotton is pictured as a sheet of uniform thickness and a beam of light is directed at it, most of the light will be reflected but some will be diffused through the sheet. This is shown in Fig. 3(*a*). Light transmitted through the cotton will be absorbed by the black surface when this is used as a background (Fig. 3(*b*)). If a white surface, such as a standard of high reflectance or additional clean white cotton cloth, were placed on the back side (Fig. 3(*c*)), a portion of the transmitted light will be reflected back through the sheet. It is clear, then, that the reading is influenced by the reflectance of the background. When using a black background, the measured value is mainly the reflectance of the fabric-air interface, and with the white backing or additional layers of cloth, the measured value includes light reflected from more than one surface.

Three advantages are realized when a black background is used instead of additional cloth as backing or a white background:

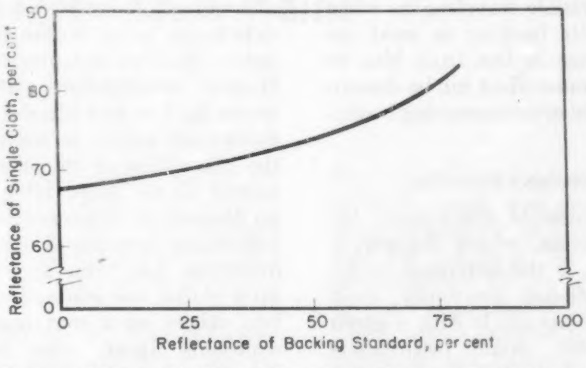

Fig. 2.—Effect of Different Standard Plates on Reflectance.

1. *Neater Operation.*—When no additional cloth backgrounds are used, the procedure is less cumbersome and there is less chance of the fabric's wrinkling.

2. *Higher Precision.*—When the test cloth exhibits a lower reflectance value, the reading can be made with a higher degree of precision on the Hunter Multipurpose Reflectometer. This effect is conveniently illustrated in Fig. 4, where the sensitivity of this instrument is plotted as a function of reflectance value.

3. *Accentuates Surface Soil Effects.*—Another reason for preferring a black background with no additional cloth backings is that a more reliable measure of the air-fabric interface is obtained. In Table II, a difference of 1.3 percentage points in reflectance exists between two swatches when backed with black. The white background fails to bring out any difference.

The only reason a white background would be preferred is that the natural reflectance of fabric might be indicated if it were in powdered form or if multiple thickness occurred—as, for example, when a sheet is folded for storage.

Use of detersive index formulas such as the one for detersive efficiency will not eliminate differences due to backings. The values of a typical test in which the backing procedure differed are shown in Table III. The use of different backgrounds results in a discrepancy in the relative detersive efficiency values. The same effect can be illustrated in terms of other formulas. Use of different backgrounds gives cloth different hues (chroma) as well as re-

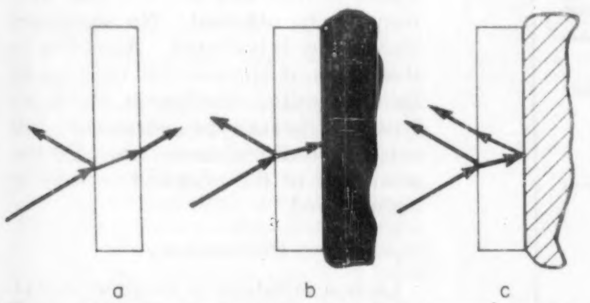

Fig. 3.—Diagram Illustrating Effect of Background on Cotton Fiber.

(*a*) No backing. Some light transmits through sheet, continuing in same direction.
(*b*) Black backing. The portion of light which is transmitted through sheet is absorbed on opposite side by black background.
(*c*) White backing. The portion of light which is transmitted through sheet is reflected back through sheet by the white background.

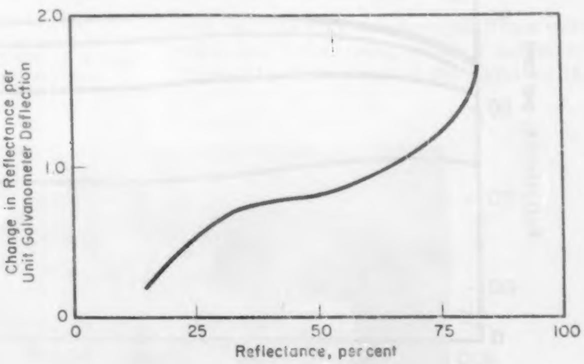

Fig. 4.—Sensitivity of Hunter Multipurpose Reflectometer at Various Levels of Reflectance.

TABLE III.—EFFECT OF BACKGROUND ON DETERGENCY INDEX.

Condition of Cloth	Symbol	Reflectance, per cent: Black Backing	Reflectance, per cent: Five Additional Cloths Backing
Original	R_O	68.0	85.0
Soiled	R_S	20.0	20.1
Washed in product A	R_A	41.1	41.8
Washed in product B	R_B	59.3	67.0
Decrease, soiling	R_O-R_S	48.0	64.9
Increase, product A	R_A-R_S	21.1	21.7
Increase, product B	R_B-R_S	39.3	46.9
		RDE,[a] per cent	
RDE[a] of product A	100% × (R_A-R_S)/(R_O-R_S)	44.0	33.4
RDE[a] of product B	100% × (R_B-R_S)/(R_O-R_S)	81.9	72.3

[a] Relative detersive efficiency.

flectances. This is illustrated in Fig. 5 on the spectrophotometric curve. The shift in the peak reflection region from short to long visible wavelengths when additional cloth backing is used indicates a change in hue from blue to yellow. This same effect can be demonstrated on other color-measuring instruments.

Fluorescent Effects

A further cause of discrepancy between instruments, where fluorescent dye is present, is the difference in design. As mentioned previously, most of the readings are made with a green tristimulus filter. Some instruments have this filter situated between the light source and test surface, whereas others have it between test surface and measuring photocell. In some cases no filter is used. Optical bleaches owe their whitening action to the fact that they absorb invisible ultraviolet radiations and re-emit these in the visible blue region. When cloth containing fluorescent dye is illuminated with incandescent lamp light, there is enough ultraviolet radiation to cause some fluorescence.

Where unfiltered incandescent light illuminates the cloth in any of these photometers, such as the Hunter Color and Color Difference Meter, part of the reflectance value is due to fluorescent light. In other instruments such as the Hunter Multipurpose Reflectometer, where light is first filtered, this type of fluorescent action is negligible due to the absorption of the ultraviolet component by the green filter. Therefore, no fluorescent action occurs, and a true reflectance measure is obtained. This difference has been shown when the same cloths, one containing no dye and two others each containing a typical whitening agent, were measured on these two instruments that differ in the location of their filters. Table IV indicates that the reflectance of the dyed cloth on the Hunter Color and Color Difference Meter is 0.5 unit higher than it would be if the light were first filtered.

Faulty Optical Alignment

When the instrument is in good working condition, use of different rated reflectance surface for standardization should not lead to major discrepancies, especially when using the calibration correction curves. On the other hand, use of the same standard on an instrument in which the optical alignment is poor will not give the same reflectance values as it would on a good working instrument. One such case that can be mentioned is the Hunter Reflectometer, which has an auxiliary condensing lens used for reading small areas. Sometimes this lens may be positioned in such a manner that the beam is not properly focused, thereby illuminating additional nonspecimen surfaces. This results in the high reflectance items reading lower than the rated value and *vice versa*. External light leakage can induce the same errors. Anyone engaged in such work should first check on the accuracy of his photometer readings.

TABLE IV.—FLUORESCENT EFFECTS.

	No Dye	Dye A	Dye B
Reflectance on Hunter Multipurpose Reflectometer	85.4	85.0	84.7
Reflectance on Hunter Color and Color Difference Meter	85.6	85.7	85.4
Difference between the two instruments	0.2	0.7	0.7
Difference between instruments correcting for 0.2 per cent error (fluorescent action)	...	0.5	0.5

Different Light Intensities

The photometers also differ in the type of illuminant used, varying from a low voltage flashlight lamp to a 300-w projector lamp. From theoretical considerations, differences in light intensities should not cause any differences in the reflectance values, provided the relative spectral emission remains constant. An example of this is shown where the same cloth was measured on the same instrument with a 200-w and then a 300-w lamp and reflectance values of 65.6 and 65.5 per cent were respectively obtained. No significant discrepancy is indicated. According to these data, it appears that variation in light intensity, whether in the same type or different type instruments, will not lead to discrepancies, provided the sensitivity of the photocell or tube is not impaired.

Conclusions

Certain variations in the procedure of measuring reflectance of detergency fabrics account for major discrepancies. This is quite evident among interlaboratory comparisons. These differences have been attributed to at least four factors:

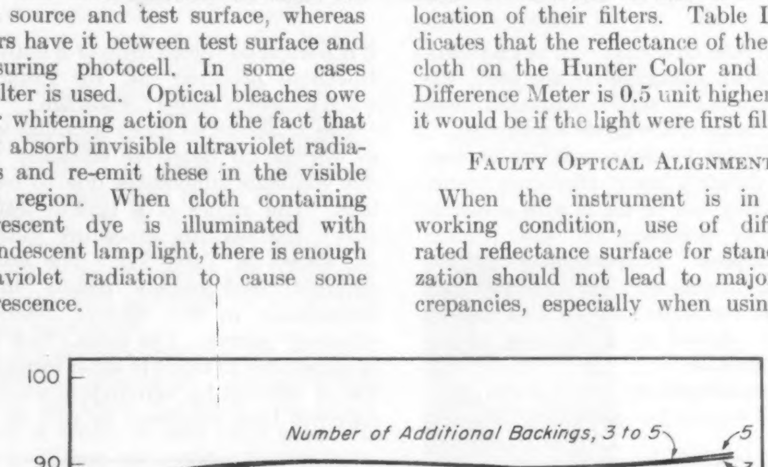

Fig. 5.—Effect of Additional Cloth Background on Spectral Reflectance. (Measured on G.E. Recording Spectrophotometer.)

1. Fabric structure.
2. Background.
3. Fluorescence.
4. Faulty lighting system in photometers.

These have been noted on the Hunter Multipurpose Reflectometer and the Hunter Color and Color Difference Meter, but in all probability they occur on other instruments as well. It is also likely that additional discrepancy factors exist in other instruments. Because these discrepancies do exist, they should be brought to the attention of all laboratory personnel engaged in detergency evaluations. The authors therefore recommend that the ASTM set up a task group to study the problem of establishing a standard procedure for reading the reflectance of detergency test fabrics.

Beaded Traffic Line Paint

By S. Werthan[1]

THE increased night visibility of glass-beaded traffic paint stripes has resulted in the increased use of beaded lines. The beaded lines are obtained either by the application of a paint in which glass beads have been mixed or by sprinkling glass beads onto the wet paint stripe. The deposition of the glass beads onto the wet paint is usually preferred because of difficulty arising from clogging of the spraying or other paint application equipment when paint in which glass beads have been incorporated is used and also because maximum night visibility is not obtained with paint thus applied until sufficient paint film has been worn away to expose part of the surface of some of the beads.

Early in the use of deposited glass-beaded lines, some difficulty was encountered because of poor embedment or wetting of the glass beads by the paint and because of complete coating of the glass spheres by the paint. A procedure for determining and rating the wettability of glass beads applied to traffic paint was developed in the paint laboratory of The New Jersey Zinc Co. (of Pa.). At the request of Subcommittee IV on Traffic Paint of ASTM Committee D-1 on Paint, Varnish, Lacquer, and Related Products, this procedure was drawn up in the form of an ASTM test method. The wettability of glass beads at present does not seem to be a sufficient problem to justify the publication of an ASTM method, but it is published herewith as information.

PROPOSED METHOD OF EVALUATION OF THE DEGREE OF WETTABILITY OF REFLECTORIZING GLASS SPHERES BY TRAFFIC PAINT

Scope

1. This method of test is intended for determining the degree of immersion of glass spheres into paint films. It may be used for evaluating different paints, using a specified grade of glass spheres, or for evaluating different glass spheres, using a specified paint.

Apparatus

2. The apparatus shall include the following:

(*a*) *Paint Film and Glass Sphere Applicator.*—This may be the Combined Film Applicator and Bead Distributor (Fig. 1) developed by The New Jersey Zinc Co. or any conventional type draw-down gage[2] that casts a film having a minimum width of 2 in. and an approximate wet thickness of 0.015 in. (applicator clearance being approximately 0.03 in.) and that has a suitable mechanism[3] for distributing the glass spheres.

(*b*) *Test Panels.*—Smooth glass plates at least 4 by 15 in.

(*c*) *Level, Timer, Spatula.*—A small level, clock-type timer or stop watch and laboratory spatula.

(*d*) *Microscope.*—A low-power binocular microscope capable of a magnification within the range of 30 × to 80 ×.

(*e*) *Diagrammatic Graph,* rating the degree of immersion of the spheres in the paint film on a scale from 0 to 10, or suitable photographs showing various degrees of immersion.

Procedure

3. (*a*) Place a clean glass plate on a work table and level, using shims if necessary. Make the draw-down of the paint on the

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[1] Research Division, New Jersey Zinc Co. (of Pa.), Palmerton, Pa.

[3] The Bird Film Applicator or any other device for making a drawn-down of a wet film thickness of approximately 0.015 in.

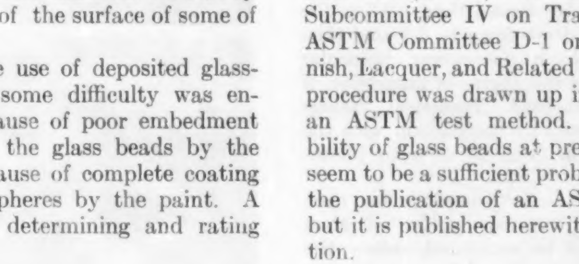

Fig. 1.—The New Jersey Zinc Co.'s Combined Film Applicator and Bead Distributor.

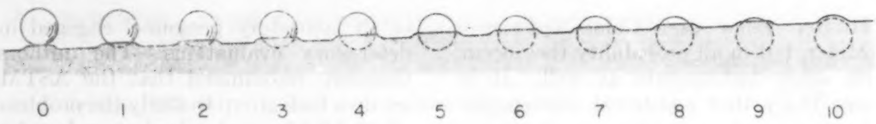

Fig. 2.—Standard Scale for Wettability of Glass Beads.

glass plate with the gage and apply the glass spheres to the wet draw-down after a specified elaspsed time.

(*b*) In the case of The New Jersey Zinc Co.'s combined film applicator and bead distributor, place the apparatus on the leveled glass plate and connect it to an electrical outlet. Put a small quantity of the standard spheres in the slitted semi-cylindrical container, and after placing a quantity of the thoroughly mixed test paint in front of the paint spreader, start the vibrator and the timer and the drawing-down of the paint film. Continue the travel of the apparatus at a steady uniform speed until at least a 3-in. stripe of "beaded" paint film is obtained. If the drawn-down motion is continuous and of normal speed, approximately 5 sec will elapse between spreading of the paint and application of the glass spheres. Usually a greater elapsed time is desired. In such cases do not start the vibrator with the start of the draw-down; stop the draw-down motion when the slot for distributing the spheres is even with the starting edge of the paint draw-down. Start the vibrator and restart the draw-down after the agreed upon elapsed time. Allow the beaded paint draw-down to dry and then examine with a low-power binocular microscope for the degree of immersion of the glass spheres.[4] Numerical ratings may be obtained by comparison with the standard graph (Fig. 2) or with photographs (Fig. 3).

(*c*) Use the same procedure for each test paint. If various grades of glass spheres are to be evaluated, follow the same procedure using the agreed upon paint with each grade of spheres.

[3] Any suitable means for distributing the glass spheres on the wet paint film.

[4] Both illuminating and viewing the beaded film at an angle permit a more accurate determination of the degree of immersion of the spheres.

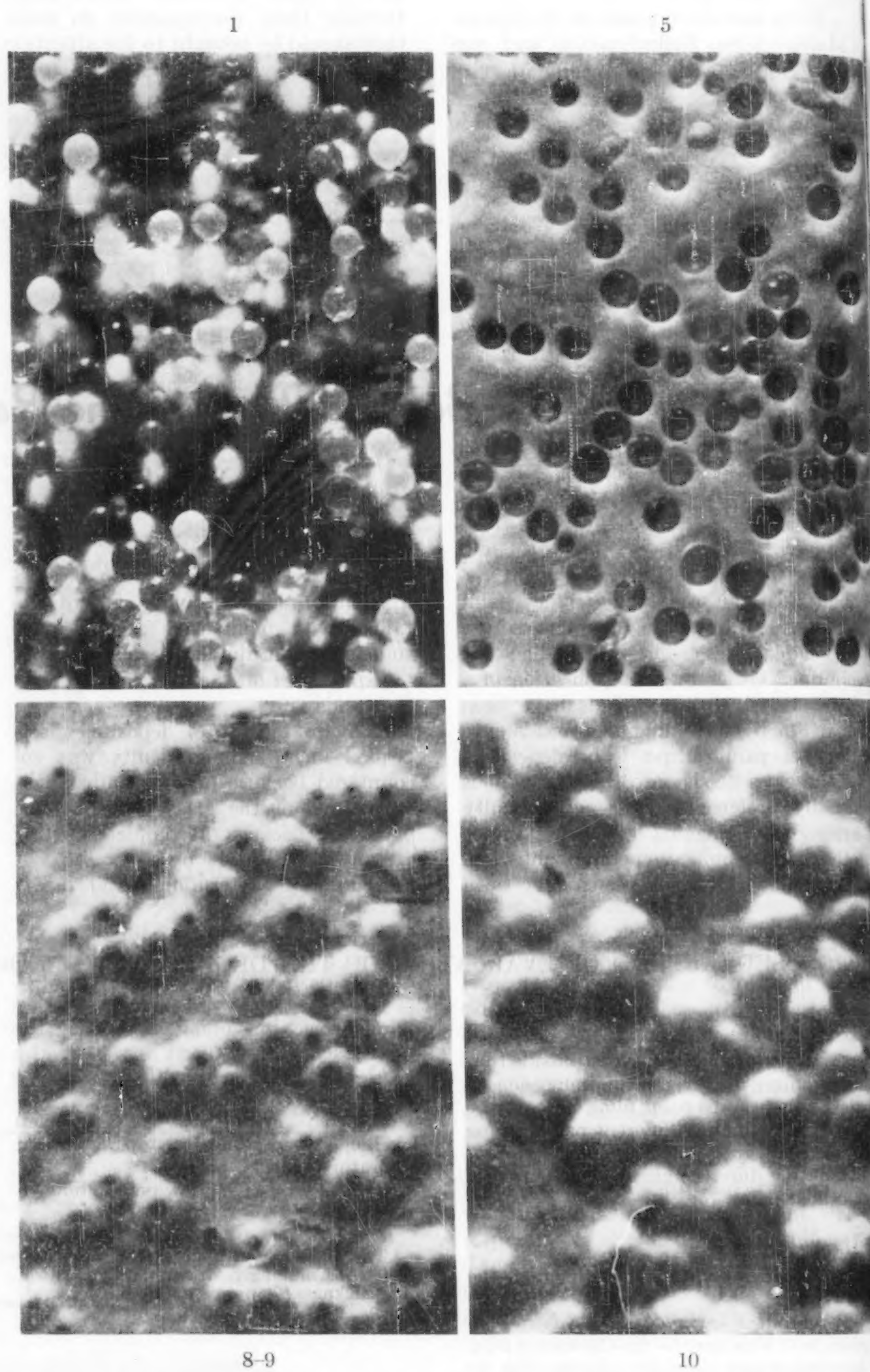

Fig. 3.—Representative Photographs Showing Different Degrees of Immersion of the Glass Beads Into Paint.

[Editor's Note.—At the Symposium on Color of Transparent and Translucent Products, which was presented at the ASTM Spring Meeting, February 3, 1954 at Washington, D. C., 7 papers, a summary, and a general discussion were presented. The first 4 papers of this symposium were published in the October, 1954, ASTM Bulletin. The remaining papers appear in this December issue. The complete symposium is also available in separate pamphlet form and can be secured from Society Headquarters.]

Color Grading Agricultural Products

By Wilbur A. Gould, Rees B. Davis, and James O. Mavis

Data show the importance of standardizing lighting and viewing conditions, and instruments for measurement and evaluation of color of agricultural products, a field in which there is a need for accepted standards of measurement and answers to many unsolved problems.

Fruits, vegetables, flowers, dairy products, eggs, honey, tobacco, cotton, meats, grains, and most other agricultural products are bought and sold on the basis of quality. The term quality has recently been defined[1] as "the combination of attributes of a product that have significance in determining the degree of acceptability of the product to a user." One of the most important attributes of quality in agricultural products is color.

In the agricultural field little progress has been made in the development of color standards or in the standardization of color evaluation methods. Further, until recently, little use has been made of objective methods for the determination of the actual color score or grade for many of the agricultural products.

In 1948 studies at Ohio State University were started on the color grading of both raw and processed tomato products (canned tomatoes, tomato juice, and concentrated tomato products). Three major problems existed: (1) what conditions (kind and amount of light) should be used for the grading of the raw and processed products, (2) what kind of reference systems (bench mark) should be used, and (3) could objective instruments be used and, if so, how should the results be interpreted.

Standardization of Visual Color Grading

During the visual grading of fresh and processed fruits and vegetables and many other agricultural products, the lack of standardized color grading conditions is most evident. Some of the more important factors to be considered in the visual color evaluation of agricultural products are (1) the need for a uniform and proper light, (2) the standardization of the intensity of light falling on the object, (3) the proper spectral energy of the light, and (4) the distribution or geometry of the lights with respect to the object. Published information shows that during daylight hours natural daylight varies between wide limits (12 to over 350 foot-candles, color temperature from 5000 to 40,000 as measured in degrees Kelvin (K), and in color from yellow at sunrise through white and deep blue to yellow at sunset). These wide variations illustrate how very unstable daylight is as a source of light for color grading. Since many food processing factories and packing plants operate longer than daylight hours and since normal daylight varies tremendously during different times of the day, with varying cloud conditions, geographic locations, and at times of the year, the need for standardization of the type and quality of light is obvious for measurement and control of color for many different products.

Since the best light for color evaluation is the light that occurs on clear days particularly around midday, and since this is not available 24 hr a day or 365 days a year, artificial light must be used. There are many different types of fluorescent and incandescent lights available. In the early work at Ohio State University, a variety of these fluorescent and incandescent lights, both singularly and in combination, was evaluated.

In the early studies at Ohio State University, lighting was standardized with 4500 K fluorescent "daylight" lamps. A light-box was constructed (Fig. 1) with the lights mounted at a 45-deg angle and the observer viewing the sample at a 90-deg angle. Although this approach was an improvement,

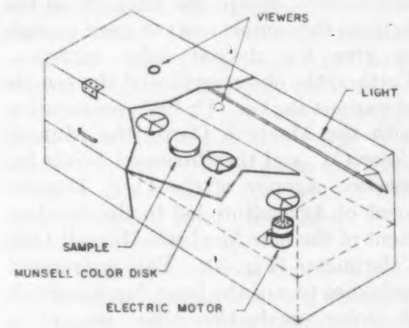

Fig. 1.—Color Comparator Box.

WILBUR A. GOULD, on the staff of Ohio State University and Ohio Agricultural Experiment Station, is directing research programs of graduate students and several station projects mainly in quality control methods emphasizing color and flavor of horticultural products.

REES B. DAVIS, an instructor in the Department of Horticulture, Ohio State University, is completing requirements for his doctorate. The subject of his thesis is the effect of maturity and processing on color of tomato juice.

JAMES O. MAVIS is completing requirements for his doctorate in the Department of Horticulture of Ohio State University and continuing color studies on tomato products.

[1] "Quality, Its Measurement and Application," 1951 Market Demand and Product Quality Report of the U. S. Dept. of Agriculture, Marketing Research Workshop, pp. 117–128 (1951).

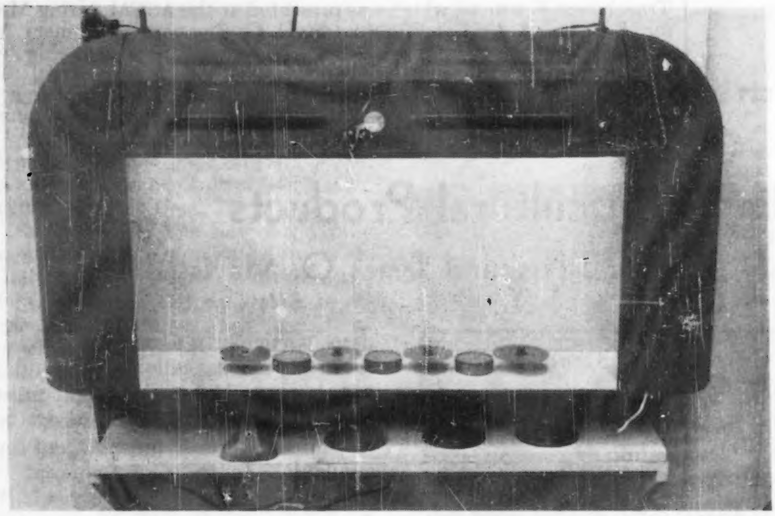

Fig. 2.—Adapted Macbeth Filtered Daylight Lamp (BBX-36 Unit) and Munsell Disk for Color Scoring of Tomato Products.

certain samples could not be correctly evaluated or matched to the standard. The next approach was to obtain a Macbeth filtered daylight lamp (BBX-36 unit) (Fig. 2). This lamp was very satisfactory, except the intensity of the light on the sample was not great enough to give the desired color rendition. Further, the observer viewed the sample at various angles. In 1951, cooperation with the Macbeth Corp., the Munsell Color Co., and the Processed Foods Inspection Agency of the U. S. Department of Agriculture led to the development of the new Macbeth-Munsell Disk Colorimeter (Fig. 3). This instrument embodies two of the basic fundamentals of color evaluation—the use of a standardized light source and a color standard for sample matching.

The unit consists of two spinning disks mounted directly beneath a color-corrected light source with controlled viewing conditions. It is essential that these variables be reduced to constants in order that the most effective and consistent color grading may be done. The light source is composed of two R40 300-w reflector flood lamps used with two $7\frac{1}{4}$-in. Macbeth daylight filters. The light source and filter combination is mounted on a deck in the upper portion of the unit and is enclosed with a special nonselective diffusing glass. The light source-filter combination produces the closest duplication of north sky daylight (7500 K) commercially available. The filters used are carefully graded and selected, and a code is etched on the rim of the filter for identification. All type No. 1 disk colorimeters are supplied with filters which produce a color temperature of 7500 K unless otherwise specified.

The center section of the unit, enclosed by two hinged doors, constitutes the viewing mask support (horizontal bar) attached to a positioning guide for a constant angle of viewing. The interior of the viewing area is painted a light neutral gray (Munsell N8/) in order to standardize the surrounding conditions when color judgments are made. The sample holder consists of two parts which include a tray and a sample cup $3\frac{1}{2}$ in. in diameter and $\frac{7}{8}$ in. deep. The cup fits against a guide on the tray which, in turn, slides on to the viewing surface by means of ways or tracks. The sample holder is constructed in this manner so that any samples which spill over from the cup will be caught by the tray which is easily removable for cleaning. The spinning disk motors are mounted on both sides of the sample holder. The standard size of the Munsell standard color disks is $3\frac{3}{4}$ in. in diameter. These color disks are punched in the center with a $\frac{1}{4}$-in. hole which fits over the spindles of the spinning disk motors. The color disks are held in place on the spindle by a knob which is a friction fit for the spindle.

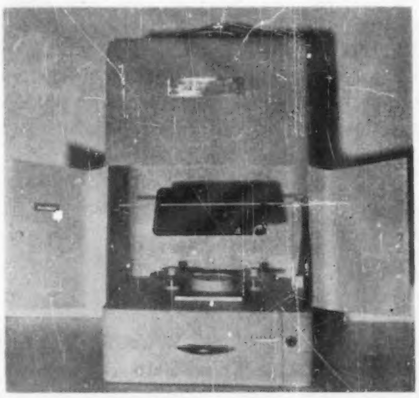

Fig. 3.—Macbeth-Munsell Disk Colorimeter.

For close control or evaluation of color of any sample, disks can be established for specific score points of different grades. Table I gives the Munsell color percentages for scoring tomato juice.

For general grading of many products where color is not so critical, the color evaluation work at Ohio State University was standardized with the Macbeth Examolite (Figs. 4 and 5). These artificial lights are similar to those used in the cotton, tobacco, grain, and many other industries where color control and specification, too, are factors in determining the product's value or worth. In the color control room 100 foot-candles of light and a color temperature of 7400 K are maintained. This color temperature is equivalent to that obtained from north sky natural daylight on a moderately overcast day. The lighting is uniform throughout the room, and illumination is closer to daylight than that obtained with ordinary fluorescent "daylight."

The illumination for the Examolite is produced by three sources of light: three 40-w (6500 K) "daylight" fluorescent lamps; two 20-w blue fluorescent lamps; and four silver bowl incandescent lamps of 25 w each. The color temperature produced is 7400 K. The Examolite light energy distribution

TABLE I.—MUNSELL COLOR PERCENTAGES FOR SCORING TOMATO JUICE.

Score Points	Grade	Red (5R/2.6/13)	Yellow (2.5 YR/15/2)	Black[a] (N1)	Gray[a] (N4)
28[b].......	A	73	16.34	5.33	5.33
26[c].......	A	65	21	7.0	7.0
24.5[b].....	C	59	24.5	8.25	8.25
23[c].......	C	53	28	9.5	9.5

[a] Any combination of neutral black and gray is allowed. For "cold break" extracted and high-temperature, short-time sterilized juice, a greater percentage of gray may be necessary to match the sample; and for "hot break" extracted and conventional processed juice, a greater percentage of black may be necessary to match the sample.
[b] Percentages determined by interpolation and research.
[c] Minimum standards established by the U. S. Department of Agriculture.

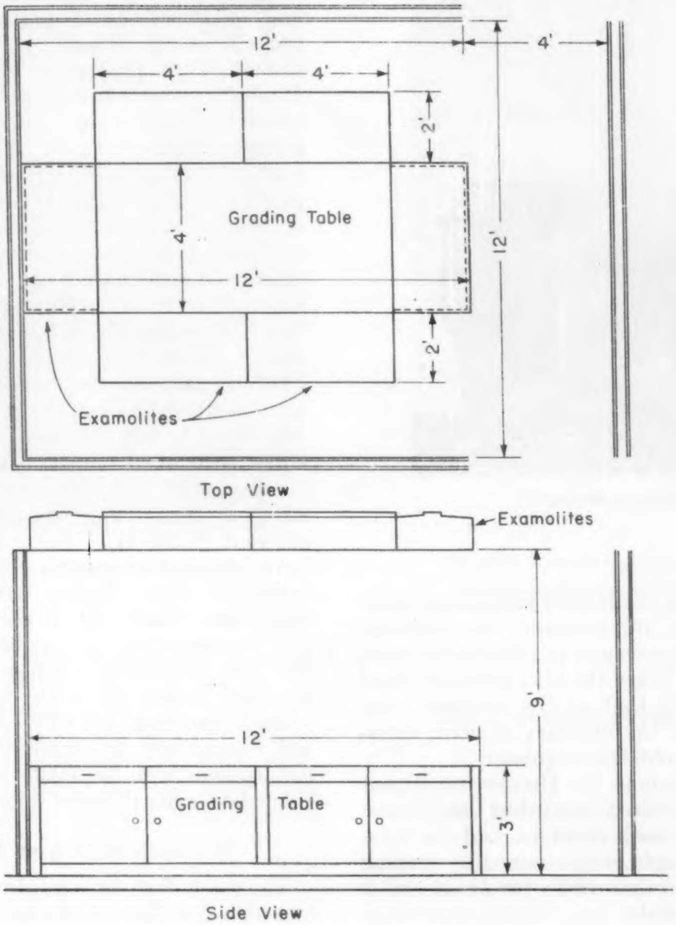

Fig. 4.—Ohio State University Color Evaluation Room.

Fig. 5.—Grading Tomatoes for Color and Other Quality Factors in the Ohio State University Color Evaluation Room.

curve has been improved over straight fluorescence by the addition of red and blue light energy to the daylight fluorescent tubes in addition to some suppression of the effect of the spectrum lines.

Recently the Macbeth Corp. announced new Macbeth Examolite tubes for use in the Macbeth Examolite. These tubes replace the three 40-w "daylight" fluorescent lamps and the two 20-w blue fluorescent lamps. With these new tubes and the 25-w metal cap incandescent bulbs, the color temperature is the same, 7400 K.

The Macbeth Examolite provides its own reflector of a permanent baked white finish, similar to a white refrigerator finish, thus eliminating variation due to reflection from a ceiling, such as occurs in open reflector type lighting where different colors and color aging alter the illumination as the ceiling color varies. In addition, the fact that the unit is closed prevents dust, dirt, and lint from collecting on the tubes and bulbs and further altering the color.

The above color control room was designed and situated in such a manner that extraneous light was blocked out to eliminate variability of illumination.

The color of the walls is a very important factor in the lighting of a color grading room. In the color control room the walls of the room have been painted a light neutral gray (reflectance of approximately 70 per cent) of a flat finish (mat 8), which has been very satisfactory in reducing glare and providing a comfortable background free from conflicting color influence for fruit and vegetable grading.

The evaluation of color by the human eye, even by comparison to a standard and under standardized lighting conditions, still has one major limitation. It is a subjective approach for the evaluation of the color of a product and, consequently, is only as reliable as the observer. This does not mean that observers as a group are not reliable but that they are subject to error. Perhaps more important is the problem of eye fatigue. In addition, the subjective approach may be time-consuming and may not always be readily applicable for complete and accurate production line color control or evaluation.

Objective Measurement of Color

In an attempt to overcome this subjective approach to color evaluation of agricultural products, workers at Ohio State University recently have dealt with the use of objective color instruments for the evaluation of the color of different food and agricultural products. Three instruments that have been used are the Hunter Color and Color-Difference Meter (Fig. 6), Agtron

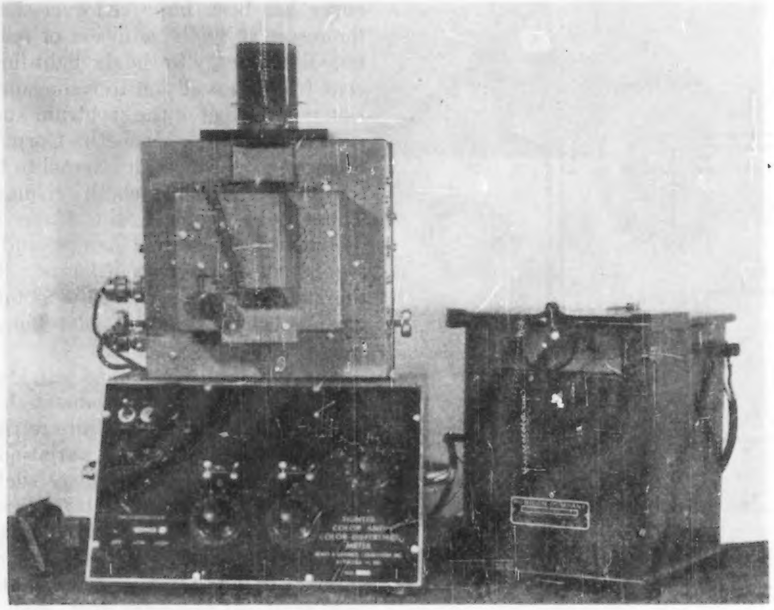

Fig. 6.—Hunter Color and Color-Difference Meter.

(Model E) (Fig. 7), and Agtron (Model F) (Fig. 8). These instruments are discussed briefly below from two standpoints—principle of operation and interpretation of specific color data.

I—Hunter Color and Color Difference Meter

The Hunter Color and Color-Difference Meter is a tristimulus colorimeter measuring color on three scales by the use of three filters that approximate the X, Y, and Z functions of the CIE system. Three values are obtained for each color measured: R_d (45 deg - 0 deg luminous reflectance) or L (visual lightness), depending on the type of measuring circuit selected; and a and b values which determine hue and chroma (Fig. 9). The unit of color measurement for these three scales is the National Bureau of Standards unit of color difference devised by Judd (**22**).[2] Hunter values may be converted to CIE coordinates by the following equations:

$$R_d = 100Y \quad (1)$$

$$a = 175f_Y(1.02X - Y) \quad (2)$$

$$b = 70f_Y(Y - 0.847Z) \quad (3)$$

$$f_Y = 0.51\frac{(21 + 20Y)}{(1 + 20Y)} \quad (4)$$

or if using the L measuring circuit:

$$L = 100Y^{1/2}$$

$$a_L = 175(1.02X - Y)/Y^{1/2}$$

$$b_L = 70(Y - 0.847Z)/Y^{1/2}$$

[2] The boldface numbers in parentheses refer to the list of references appended to this paper.

In using the Hunter instrument, color standards are necessary for accurate color measurements in tristimulus colorimetry. When the color of the standard is close to that of the samples being measured, the accuracy of color measurements obtained is greater.

In operation, the Hunter instrument is standardized according to known values for each standard, and the color of the sample is determined by reading the three values of R_d (or L), a, and b from the dials.

In interpreting Hunter data, Younkin (**47, 48**), when measuring the color of tomato puree, plotted Munsell renotation loci in terms of a_L and b_L on the Hunter type diagram at a lightness level equivalent to an L value of 25.6 (Fig. 10). This is equivalent to the Munsell value of 3/ for which Newhall, Nickerson, and Judd (**34**) have published Munsell renotations in CIE (Y, x, y) equivalents. With this type of diagram, Hunter values for tomato purees can be plotted directly and interpreted in terms of Munsell values. Although an average L or lightness value is used in plotting, interpretation of Hunter data in this manner may be satisfactory for most purposes. However, it is highly recommended that, when presenting data from the Hunter Color and Color-Difference Meter, the actual a, b, and L or R_d readings be presented. Further, the area of illumination and size of aperture should be specified. Mavis and Gould (**27**) have shown the importance of the latter since values obtained with different apertures and areas of illumination are significantly different (Table II). These differences have an effect on certain color indices calculated from Hunter data. From these data (Table II), it seems necessary to define the area of illumination and size of aperture when establishing standard values for color indices or when converting to CIE and Munsell equivalents, in order that valid comparisons can be made of Hunter color data from different sources.

II—Agtron (Model E)

The cut surface Agtron (Model E) is a two-filter (red filter at 640 mμ and green filter at 546 mμ) abridged spectrophotometer which measures the ratio of reflectance at these two points of the

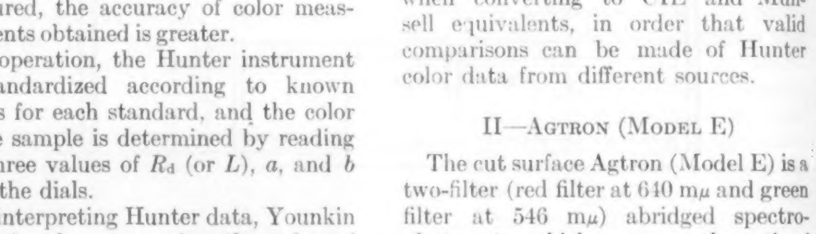

Fig. 7.—Agtron (Model E).

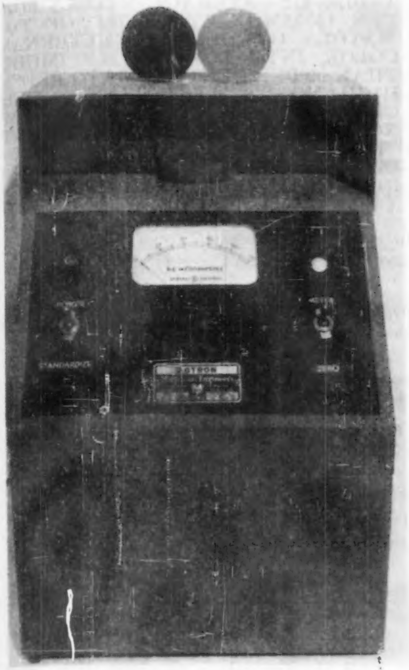

Fig. 8.—Agtron (Model F).

spectrum. The development and application of the Model E Agtron for measuring the difference in tomato color are based upon the principle that the ratio of monochromatic reflectances at wavelengths of 546 mμ (green) and 640 mμ (red) forms a dimensionless function which indicates the degree of ripeness of the tomato fruits. The ratio is based on the difference in spectral reflectance curves of four different grades of tomatoes as shown in Fig. 11.

In operating the Model E Agtron, the red and green zero levels are established by standardizing on special black disks, and the relative sensitivity of the two circuits is then standardized on a red plastic standard, similar to "tomato red." Then the two tomato halves are placed in position and illuminated by a combination of mercury vapor and neon gas discharge tube. A red filter is used to isolate the 640 mμ line of neon and the meter is adjusted to read 100. The filter is then changed to a green filter which isolates the 546 mμ line of mercury, and the Agtron reading thus obtained is the color score assigned the product. Thus, by this method the reflectances of the two monochromatic regions are compared in terms of a dimensionless ratio which is a function only of the degree of ripeness of the tomato and is independent of such variables as size and texture.

III—Agtron (Model F)

The Agtron (Model F) is also an abridged spectrophotometer in which a single filter is employed for isolating a selected monochromatic line of the light source. The instrument can be obtained with any one of three light sources and three filters—red, green, or blue. A gas discharge tube is employed as the light source for illuminating the sample. For the red measurement the 640 mμ line of neon is used, for the green measurement the 546 mμ line of mercury is used, and for the blue measurement the 436 mμ line of mercury is used. Each color measurement requires a different light source-filter combination. Therefore, it is necessary to know the color characteristics of the product in order to determine the type of light source and filter combination to be used. The color characteristics of a product are usually determined from spectral reflectance curves as mentioned above for the Agtron Model E instrument. With the Model F Agtron, the green illuminating light source and the green filter (546 mμ) are used for the evaluation of liquid or pureed tomato products.

In operation, the instrument is first standardized on zero by using a black disk, then standardized to a predetermined value by using a standard reference material near the color of the particular product being evaluated. For example, the instrument is standardized at 70 when working with tomato products, and the standard reference material used is a red plastic disk approximating "tomato red" color. The sample is then placed in position and the reading taken. The value obtained is a function of a monochromatic reflectance comparison between the sample and the standard reference material.

Table III is presented to demonstrate the type of data obtainable for one particular agricultural product of varying color differences with both the subjective and instrumentation approach to color evaluation. The values

TABLE II.—Lb/a AND a/b COLOR RATIO AVERAGES CALCULATED FROM READINGS OF 20 TOMATO PUREE SAMPLES USING DIFFERENT INSTRUMENTAL ILLUMINATING CONDITIONS WITH THE HUNTER COLOR DIFFERENCE METER.

Illumination Condition[a]	L	a_L	b_L	Lb/a Color Ratio	a/b Color Ratio
1.............	25.5	22.7	12.8	14.3	1.81
2.............	26.5	25.2	13.3	14.0	1.91
3.............	25.7	23.3	12.4	13.6	1.90
4.............	27.3	26.8	13.1	13.5	2.05
LSD at 0.01..	...	...	...	0.3	0.09

[a] 1—Small area illumination with small aperture.
2—Small area illumination with large aperture.
3—Large area illumination with small aperture.
4—Large area illumination with large aperture.
LSD—Least significant difference.

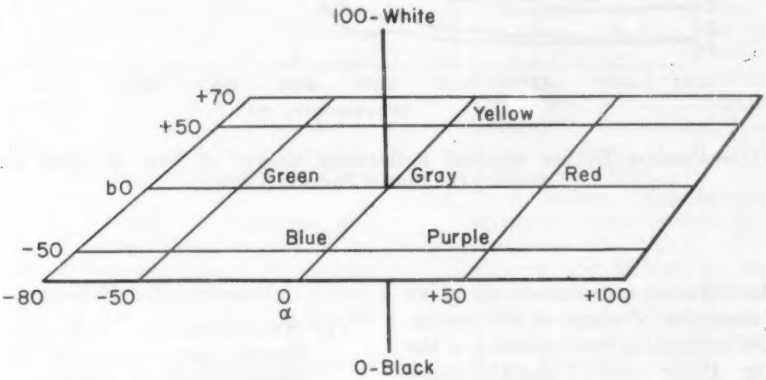

Fig. 9.—Diagram Showing Dimensions of the Hunter L, a, b Color Solid.

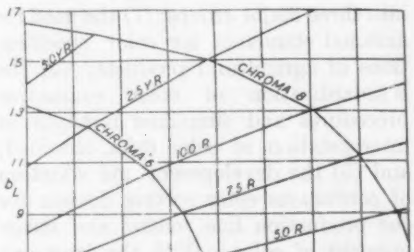

Fig. 10.—Munsell Hue and Chroma Coordinates for Value 3/ in Terms of Hunter a_L and b_L.

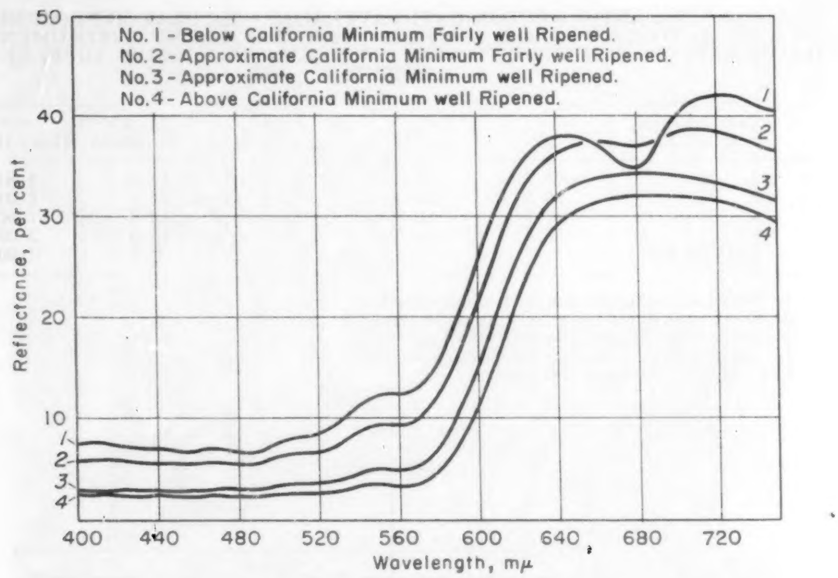

Fig. 11.—Absolute Diffuse Spectral Reflectance Curves of Vine Ripened Canning Tomatoes (California Pearson Variety).

for the different instruments are given with examples of some of the recommended methods of interpretation of the Hunter Color and Color-Difference Meter data.

Summary

In summary, this paper has indicated some of the work being done along the lines of standardization of lighting conditions, viewing conditions, and instrumentation for the measurement and evaluation of color of agricultural products. Measurement of reflected color in terms of visually understandable scales has become of considerable importance with many food products, and there is an existing need to have accepted standards of measurement in this field in order that the most economical use may be made of the available data. However, there are many unsolved problems in the color evaluation and measurement of agricultural products. These problems may be classified into three major groups: (1) the need for national standards for color specifications of agricultural products; (2) the standardization of color evaluation procedures and simplified methods of interpretation of color data obtained; and (3) the development and adoption of continuous color sorting devices for the production line control and measurement of color. With the increased emphasis on the appearance of food and agricultural products, there is ample room for considerable research and development in this field of measurement and evaluation of color of food and agricultural products.

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TABLE III.—AVERAGE VALUES FOR TEN COMMON VARIETIES OF TOMATOES GRADED ON EXTERNAL COLOR INTO LOW NO. 1'S (MORE THAN 90 PER CENT "TOMATO RED"), HIGH NO. 2'S (LESS THAN 90 PER CENT "TOMATO RED"), AND LOW NO. 2'S (MORE THAN 66⅔ PER CENT "TOMATO RED") UNDER STANDARDIZED LIGHTING CONDITIONS (30 REPLICATES OF TEN TOMATOES EACH).

Method	U. S. Dept. of Agriculture Grade—Raw Product		
	Low No. 1	High No. 2	Low No. 2
Cut surface			
Agtron E	43.9	46.9	67.7
Puree or pulp			
Agtron F[a]	39.5	42.8	64.3
Hunter L value[b]	24.1	24.8	27.7
Hunter a value[b]	22.2	21.7	17.6
Hunter b value[b]	10.8	11.2	12.6
a/b ratio[c]	2.06	1.94	1.40
Lb/a ratio[d]	11.7	12.8	19.8
$(a^2 + b^2)^{1/2}$[e]	24.7	24.4	21.6
$(a^2+b^2+L^2)^{1/2}$[f]	34.5	34.8	35.1

[a] Agtron F standardized at 70 with the "tomato red" disk.
[b] All Hunter values obtained with small area illumination and small aperture with instrument standardized by using a "tomato red" porcelain tile with instrument setting as follows: L, 25.59; a_L, +27.40; and b_L, +12.54.
[c] The a/b ratio is highly correlated with dominant wavelength.
[d] Ohio State University color index for tomatoes and tomato products.
[e] A measure of saturation.
[f] Gardner's Delta E value.

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Colors of Transparent Liquids for Surface Coatings

By Francis Scofield

While satisfactory single-number standards are available and can be improved, basic psychophysical research is needed for significant measurement improvements in this field.

The surface coating industry has for many years measured the colors of the transparent materials it uses by single-number systems. These systems, of which the Gardner 1933 standards are typical, have given fairly satisfactory performance—sufficiently so that any effort to persuade the industry that another system using more than one number is necessary is likely to have a poor reception.

Limitations of Single-Number Color Gradings for Surface Coatings

In a few cases, however, the particular system in use breaks down, usually because the material under examination differs too widely in hue from the standard to make a satisfactory match possible. In some cases this has led to the proposal of new systems which differ from the Gardner series in spacing, in the hue of the standards, or in the depth of liquid to be examined. These only serve to confuse the issue further and, since they are rarely chosen to bear any relation with any other system, translation from one system to another is difficult, if not impossible.

This difficulty is shared by similar single-number systems designed for petroleum, edible oils, inedible tallows, and other materials. After 30 years of trials it is becoming obvious that, while it is possible to develop a single-number system that will deal with a large majority of the materials of a given class and deal with them rapidly, simply, and accurately, no single-number system is possible which will deal with everything that is presented to it.

Of course, transmission measurements may be made with a spectrophotometer and the results reported in the CIE or any other convenient system, but such a procedure, while useful for certain research and control problems, is not much help in commercial transactions involving these transparent products. There is no readily apparent correlation between the CIE results and visual gradings, and no known transformation improves the situation measurably.

Origin of Difficulties in Improving Color Grading

The difficulty seems to lie in a lack of fundamental research, which makes it impossible to develop the empirical knowledge intelligently. There are a number of relatively simple questions for which there are no answers, and until these answers are obtained, it is difficult to see how a system can be developed which will be significantly superior to any now in existence.

The first of these questions deals with the relation between what is measured with the spectrophotometer and what is normally seen. In the field of surface colors the psychophysical relationship is fairly well developed, and there are a number of three-dimensional color spaces that come very close to presenting a one-to-one correspondence between what is measured and what is seen. Attempts to teach varnish and oil technologists to see what the CIE system measures have not been successful. In many respects the "color solid" that represents this group of red-amber-yellow materials behaves rather like a two-dimensional, although sharply curved, surface. If it has a third dimension, it is much restricted compared with the other two, and the industry does not have even a vague idea of its shape or properties.

Another question concerns the mental processes by which color matches of this type are made. It is common experience to have matches made between a sample and standard which differ widely in transmission and which may also differ in the other attributes of color. These matches are often reproducible with remarkable precision by several operators if the differences are not too great. It would appear that there is some mental process by which samples that fall off the locus of the standards are brought back to that locus and that this mental process is sufficiently standardized so that widely differing observers can reproduce it. But what this process is is not known. There is no guide by which to calculate what standard a given sample will match if the given CIE coordinates fall off the locus of standards.

A third question concerns the visual spacing of standards. While some information on this has been developed empirically, the author knows of no one who would undertake to develop another set of standards like the Gardner standards but redder in hue, and guarantee to produce steps equivalent to those of the Gardner standards. Such a procedure might be possible on a strictly empirical basis, but there is no theory on which to operate.

The last question is essentially a psychological one. The surface coating industry, as well as a number of other industries with similar problems, thinks of color of a liquid as an inherent property of that liquid, like the specific gravity. It is not regarded as a variable which changes with the thickness of film or other variations in the conditions. For this reason there is a tendency to make a mental correction when comparing liquids at different thicknesses. The magnitude and precision of this correction are unknown, but it is a phenomenon which must be allowed for in any fundamental research into this question.

Summary

In the fields of colors of transparent liquids for surface coatings, fairly satisfactory single-number standards are available. There is, undoubtedly, room

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for improvement in the spacing of these standards, in the materials of which they are made, and in the conditions under which they are used. However, until such time as some fundamental psychophysical research gives the answer to some of these unanswered questions, improvements will be in detail only.

DISCUSSION

MR. SIDNEY NEWHALL.[1]—The type of correction for depth to which the author referred was not quite clear to me. Does he feel that visual comparisons involving clear varnish layers of different thicknesses are likely to be affected by some tendency in the observer to adjust or correct for perceived thickness? Thus, if there were no compensation, a thicker layer of a given varnish would be expected to appear more saturated; but if there were compensation the thicker layer should be closer in appearance to a thinner layer.

MR. FRANCIS SCOFIELD (*author*).—I do not pretend to understand the mechanism involved, but a varnish man presented with a quart jar of a varnish will guess at its color in terms of the Gardner tube which approximately 1 cm of thickness would match, not the appearance of the larger sample. In other words, the "color" is an inherent property of the material. It has only a limited relation to the appearance which the material presents under specific conditions of observation.

MR. NEWHALL.—Perhaps compensations of this sort could be avoided by eliminating the differences in apparent depth. This might be accomplished by arranging a viewing situation which suitably masks the specimens to be compared.

MR. SCOFIELD.—Instruments like the Dubosq Colorimeter are designed to eliminate the difference in apparent depth and largely do so. However, I believe that the sensation of depth is part of the judgment of colors of liquids. By various optical expedients we can transform the color judgment situation with liquids into the comparison of surface colors but the result is often not the same.

MR. B. A. SILARD.[2]—To me the problems in vegetable oils, varnishes, lacqers, and so forth, are not so very different from other liquids. I think that methods worked out for other materials, starting with sugar solutions and going through glycerin and others, have shown us that. A single-number system lends itself to photometric measurements, as long as the pitfalls offered by each individual material are avoided.

A very good example may be the measurement of color in lubricating oils. Research Division IX of Committee D-2 on Petroleum Products and Lubricants a number of years ago developed a proposed method where an excellent photometric measurement correlating with the Union Colorimeter was introduced. I believe that earlier this morning while I was absent Mr. Hancock gave in his paper some details on this photoelectric color measurement of lubricating oils. I feel it is a successful method, and the work was warranted, because people who knew where the pitfalls were and could avoid them, were in on that project.

If the Union color scale had been as well re-established as it is today, the success of that photometric method probably would have been smaller; it was successful largely as a result of the unsatisfactory visual measurements of that time.

MR. SCOFIELD.—I agree that the problems of various other liquids do not differ much from those of varnishes and drying oils. Whenever you have a single-number system of color grading, you can measure the results photometrically. I do not believe that you have improved anything except the precision by doing so. You certainly have not done anything to improve the correlation between your grade and what the user sees. It is the failure of this correlation which is the fundamental cause of the dissatisfaction which exists at present with most of the users of these systems.

[1] Eastman Kodak Co., Rochester, N. Y.

[2] Photovolt Corp., New York, N. Y.

Color in Dairy Products

By Mark Keeney

THE major dairy products—milk, cream, butter, cheese, ice cream, evaporated milk, and powdered milk—are opaque. Cheese whey is translucent. Pure butterfat when melted is a yellow transparent oil. The appearance of dairy products is of practical importance; however, the complex factors involved in the appearance make it difficult to apply objective color measuring methods to them. The few serious efforts that have been made in measuring the color of dairy products have been confined to the research laboratory.

Milk is a white opaque liquid because of the light-reflecting properties of colloidally dispersed proteins, colloidal phosphate, citrate salts of calcium and magnesium, and emulsified butterfat globules. Light is also scattered by the protein micelles, a condition that accounts, in part, for the slightly blue color of skim milk. Riboflavin is responsible for the yellow-green color of whey. Carotene and xanthophylls impart the yellow color to butterfat.

Milks from different cows will vary slightly in appearance due to differences in feed and physiology which, in turn, cause differences in the composition of the milk. The intensity of yellow color in butterfat is dependent upon the amount of yellow fat soluble pigments in the cow's diet. Physiological disturbances in the cow, such as mastitis, will change the composition of milk. Milk from mastitic cows may have a higher sodium content and lower calcium content, a condition that influences the properties of the colloidal particles to change their light-reflecting properties.

Pasteurization of milk may increase its opacity by the effect of heat in increasing the size of the colloidal particles and the formation of new particles due to coagulation of albumin and precipitation of calcium phosphates and citrates. Homogenization increases the light-reflecting property of milk by increasing the total fat globule surface area. The color imparted by milk or cream to such foods as coffee and soup is, to a large extent, dependent upon light-reflecting properties. Homogenized milk will yield a lighter colored coffee than unhomogenized milk. The boiling of many milk-containing soups will cause almost complete coagulation of the milk proteins, resulting in visible curd particles and a watery appearance in the bulk of the liquid.

Appearance of dairy products is of practical importance, but the complex factors involved in the appearance make it difficult to apply objective color measuring methods to them.

The exposure of milk to light causes the development of an off-flavor called "sunlight flavor" and may also cause oxidation of the milk fat with accompanying tallowy flavors. The use of the transparent glass bottle in distributing milk has the advantage of exhibiting the clean white color of milk, but it makes milk susceptible to the development of objectionable flavors.

The battle between butter and margarine for the "spread" market is a familiar one. For a number of years, the yellow color of butter served to distinguish it from competitive spreads which were white. The repeal of the taxes on artificially colored margarine was followed by a climb in the per capita consumption of margarine and a corresponding decrease in the consumption of butter. Color was thus a major factor in the shift of a multimillion dollar market.

The dairy industry uses artificial colors in some of its products. Some butter manufacturers add approved yellow color to butter in the winter season in order to standardize the color throughout the year. Cheese may have yellow color added to it. Such artificial coloring of both butter and cheese is, to a large extent, governed by the customs and demands of different markets. The control of color in dairy products is done mainly by the "guess and by gosh" method. The butter maker or cheese maker has learned from experience approximately how much color has to be added, and his eye is the judge of color quality.

Evaporated milk has probably been the subject of more color research than any other dairy product, because the high-temperature sterilization employed in manufacture causes development of a brown color in the product. The objective of the manufacturer is to try to hold this brown color development to a minimum consistent with the other properties desired for the product.

Webb and Holm (**1**)[1] in 1929 applied the Munsell (**2**) color system to the study of evaporated milk. They concluded that the effect of heat, whether encountered during forewarming, sterilization, or storage, was found to produce important changes in color. An increase in heat produced an increase in color, the change being of a catalytic nature. Increase in heat during sterilization deepened color by affecting brilliance, chroma, and hue, whereas increase in time and temperature of storage deepened color through increase in chroma only.

Bell and Webb (**3**) in 1943 reported on the use of the Munsell system as described by Nickerson (**4**,**5**) in studying the color of evaporated milk manufactured with various heat treatments. They reported that concentrated milk may have a color of $9.00Y/9.55/1.30$ (hue/lightness/chroma), whereas its color after sterilization may be $3.30Y/9.00/2.85$. Sterilization decreases the percentage of yellow and white and increases the percentage of yellow-red and neutral gray. Or, expressed in terms of the three color attributes, sterilization changes the hue toward yellow-red, decreases the lightness, and increases the chroma. They also reported that, although all control samples in their experiment were prepared in the same way with identical equipment, the control of one day had a hue of $3.95Y$, lightness 8.82, and chroma 3.00, while the comparable values of the control of another day were $2.75Y$, 9.00, and 2.85. These intercontrol differences in color attributes exceeded most of the intraexperimental differences reported.

[1] The boldface numbers in parentheses refer to the list of references appended to this paper.

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From this it would appear that the differences in the color of evaporated milk are due not only to processing methods but also to differences in the raw milk from which the product is prepared.

Nelson (6) used a Beckman spectrophotometer with reflectance attachment to study the color of evaporated milk. He stated that sterilization of milk produces a marked decrease in reflectance at all wavelengths, especially marked in the violet region, and that this inequality in reflectance loss is the primary reason for the brown appearance of sterilized evaporated milk, since the result is a relative increase in red and yellow and not an actual increase in these colors. He also stated that in the routine grading of freshly sterilized evaporated milk it is desirable to know the relative color of milk in terms of a simple index number. Although this index number cannot accurately represent the true color, it can indicate the direction of shift in hue, brightness, and chroma and thus afford the inspector a quick estimate of the change in color. Since the heat treatment of milk produces a loss in reflectance, especially marked in the green region, a wavelength of 520 mμ appears particularly suitable for routine work on standard evaporated milk, because small visual changes give large instrumental readings.

Kass and Palmer (7) demonstrated in 1940 that the brown pigment formed in heated milk is strongly absorbed on the casein micelles. Some years later Choi (8) suggested a method for determining the color of milk products which involved hydrolysis of the protein with trypsin, a process which apparently liberated the brown pigment into a clear solution in the milk serum. The filtrate obtained from a mixture of the hydrolyzed milk and trichloroacetic acid was analyzed for light transmission in a Pfaltz and Bauer fluorophotometer with filter No. 485. Patton (9) later used the Choi hydrolysis procedure and measured the optical density in a Klett-Summerson photoelectric colorimeter with a No. 52 filter. Patton reported that filtrates from unheated milks gave uniform optical densities of 0.015 ±0.005. The optical densities of commercial evaporated milks ranged from about 0.070 to 0.120 dependent upon the age of the milks. It is of interest to note that Patton measured the amount of light absorbed by evaporated milk filtrates at about 520 mμ, while Nelson (6) measured the reflectance of light by milk at 520 mμ.

In closing, it is suggested that there is need for objective methods to measure the color of dairy products. However, the complex nature of these products is a hindrance to the development of such methods.

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General Discussion

Mr. Victor R. Dietz[1].—May I ask Mr. Gould how the spinning disk stands up in routine measurements? Is a new disk needed periodically and how reproducible are they?

Mr. Wilbur Gould.[2]—The new disks used on the Munsell unit are mounted on a heavy plastic base; however, there is a problem of spattering juice on them, but they have a very glossy surface.

We have had some in use for about four years. We found discrepancies in the disks, depending on how old they were. I believe the newer batches are pretty well standardized. We have had the new disks about a year and a half. The last one, as far as I know, is as good as it was when we started.

Miss Dorothy Nickerson.[3]—I should like to make this statement, just for the record. Mr. Keeney said that there had been, as far as he knew, no use made in the dairy industry of color measurements. I recall, however, that as early as 1930 Webb and Bell were making measurements of evaporated milk and other dairy products by disk colorimetry.

Mr. B. A. Silard.[4]—Mr. Gould did mention one nice trick of how to measure color in such things as broccoli and other vegetables which exhibit a rather nonuniform color. I cannot recall now the name of the author who applied the principle of spinning the object to be measured for reflection in order to mix the colors of the various parts. He was connected with one of the fruit-and-vegetable branches of the Department of Agriculture.

Mr. Deane B. Judd.[5]—I think the inventor of that method might have the last name of Nickerson; I am not sure.

Miss Nickerson.—It is true that I worked closely in early years with the fruit and vegetable groups, but as far as I know the spinning of samples in the U. S. Department of Agriculture, to which Mr. Judd refers, began about 1924 with work on hay. When I first went to the Department of Agriculture, they spun a whole section of a bale of hay in a device which took a $\frac{3}{4}$-hp motor to run. Later Bausch & Lomb worked out a special arrangement for their HSB Color Analyzer (a disk colorimeter) so that the sample as well as the disks could remain stationary, and the colors of each be mixed by optical means.

Mr. Dietz.—May I ask if spinning crystals of sugar would help in the determination of crystal color?

Mr. Elmer J. Culp.[6]—I think there is no doubt that that would help, but we still cannot get away from the fact that people are not interested in the color of crystals. It is the solution color that really counts.

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[4] Vice-President, Photovolt Corp., New York, N. Y.

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[6] Technical Director, American Sugar Refining Co., New York, N. Y.

Summary

By Deane B. Judd

It is convenient to begin this summary by arranging the various fields of work in order of difficulty. Some of these papers deal with very complicated and difficult problems; others are about less complicated problems. Then it will be helpful to try to see what makes the various problems easy or difficult.

The following are the various topics arranged from easiest to most difficult: brewing, sugar, petroleum products, paint vehicles, glass, plastics, agricultural products except dairy products, and finally dairy products.

What is it that makes this order reasonable, if it is reasonable?

Diversity of Spectral Type

The first characteristic to be discussed is diversity of spectral type of absorption of the materials being dealt with. This is mentioned in a number of the papers. There is a special name for it when the colors are identical; it is then called metamerism.

In dealing with a single colorant, it may be characterized in solution by its spectral absorbancy index, $(\log 1/T)/bc$, where T is transmittancy, b is cell thickness, and c is concentration of the colorant. This index is independent of concentration and cell thickness. If this index is plotted against wavelength, a curve results which characterizes the material. If there is merely a question of more or less of this one material as evidenced by a greater or lesser cell depth or concentration, exactly the same curve of absorbancy index against wavelength will result.

In the discussion of color problems in the brewing industry, there was no mention of a correction for turbidity; it is possible, apparently, to filter the beer. A spectral type results in which absorbancy index plotted against wavelength is virtually the same for all beers, regardless of the manufacture; that is, all brewers are working with essentially one colorant.

As a result of this, the color problems in the brewing industry can be dealt with in terms of a one-dimensional scale based on the spectrophotometer alone. This is a highly desirable thing to do, if it is possible. Since it apparently is possible in the brewing industry, I thought these workers had the easiest job. They may have done the best job; but they could not have done it if it were not for the fact that the absorbancy index for all beers is substantially the same, that is, has the same spectral shape.

Working with sugar is a little more complicated, because this close approach to identical curve shape does not exist. We have the situation where, as was shown in the paper by McGinnis presented by E. J. Culp, there are moderate spectral differences to deal with, particularly in going from beet to cane sugars.

In trying to derive the one-dimensional standards for colors in petroleum products, a similar complication was evidenced by the fact that some oils are too red and others are too green to match the standards.

In reference to paint vehicles, Francis Scofield spoke of the same thing. He said that operators here really could not get along with one scale. He thought it would be desirable to have a set of one-dimensional standards for the average paint vehicle, but actually it is necessary to have at least one more on the reddish side and one on the greenish side.

There is, then, a little more diversity of spectral type in paint vehicles than in petroleum products, which, at least hopefully now, are being dealt with by means of a single one-dimensional scale.

In glass, A. J. Werner [paper not published] dealt with his problems spectrophotometrically, but he could not deal with them on a one-dimensional scale because he has glasses with problems involving variations in spectral character. He used the spectrophotometer plus the CIE system to solve his problems, and it seemed that the CIE system was very appropriately used.

Light Scattering

If light scattering cannot be eliminated, the worker is in a difficult position, because the combined effects of scattering and absorption are complicated.

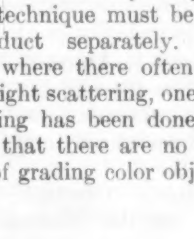
In brewing, there is no turbidity problem since apparently it is possible to filter the beer. In sugar, there are ways, perhaps not thoroughly established, of dealing with turbidity. One way is to filter it, but since this is too time-consuming, a method has been developed that could be applied to unfiltered sugar solutions to make a correction for turbidity.

Similarly in petroleum products, turbidity can be eliminated. If waxes introduce turbidity, the specimen is heated to melt the wax. H. M. Hancock and J. J. Watt did not deal with turbidity at all, so perhaps petroleum products might have to be rated easiest on the basis of light scattering.

In paint vehicles and in glass, turbidity is not a great problem. But in plastics one must deal with opaque as well as transparent specimens. G. W. Ingle's suggestion for a one-dimensional number to indicate the departure from a clear plastic, or from a white, opaque plastic, has to take this into account; he must deal not only with light transmission but also light scattering.

In agricultural products, except dairy products, it is always necessary to deal with a large amount of light scattering. It is impossible to get rid of it; these products are translucent. In dairy products, the translucency might be said to approach complete opacity.

An elegant solution has been found for the color of brewed products, reasonably good solutions are available for sugar and petroleum, and probably comparable ones for paint vehicles. In glass the problem is solved with a spectrophotometer and the CIE system. For plastics, however, Ingle's color index is just being proposed. Agricultural products are obviously very difficult; a special technique must be found for each product separately. In dairy products, where there often is a high degree of light scattering, one might say that nothing has been done at all, in the sense that there are no recognized methods of grading color objectively.



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One-Dimensional Scales

The fact that the group of colorants present in a product exhibits a restricted degree of metamerism leads naturally to the development of one-dimensional color scales of more or less satisfactory application to that product.

In beer the problem is solved by a very simple one-dimensional scale based upon a measurement of absorbancy index at one particular wavelength, 430 mμ.

In sugar, an attempt was made to get a one-dimensional scale based on absorbancy index measurements at 420 and 720 mμ, and a fairly good solution was obtained based on 550 mμ alone. The latter did not correct for turbidity and was applicable only to filtered solutions.

In petroleum products, there is a one-dimensional scale, the Union color scale, and for paint vehicles, Mr. Scofield implies that at least two one-dimensional scales are desirable. In paint vehicles however, there is an indication that the workers are trying to deal with a two-dimensional problem, or perhaps a three- or a 2½-dimensional problem, with a series of one-dimensional scales.

With agricultural products, particularly tomato purees, there was an effort to get a single-number specification of the goodness of tomato purees, and various numbers were plotted. One was L, a measure of lightness, divided by a, a measure of redness; another was a divided by b, a measure of yellowness. The procedure used was first to measure a three-dimensional quantity; that is, L, a, and b were measured. Then from these three numbers, a single number was derived to indicate whether the tomato puree was moderately good, poor, or premium. Even when diversity of spectral type is so great that it prohibits dealing with the problem on a one-dimensional scale, based on a single measurement—that is, even when three measurements must be made to deal with the problem adequately—the attempt is always to simplify the end result by finding some function of those three measurements that can be expressed in a single number.

Mr. Ingle's solution for plastics was an example of this. Here the tristimulus values, three numbers for each plastic, need to be measured. Then a single number is derived based on a luminous reflectance, or a transmittance deviation from standard, and on a chromaticity deviation from standard. This single number is the square root of the sum of the squares of the luminous and chromatic departures. It is the index of the color departure of the specimen from the clear plastic or the white plastic. In the plastics problem, in which there are so many spectral types, one cannot hope to get by with a single measurement; three numbers must be measured. Nevertheless, commercially, it is advantageous to look for a single function of those three numbers that will indicate what you want to know.

Pseudo Two-Dimensionality

I would like to say a few words about Mr. Scofield's remark that, in dealing with transparent liquids, there is hardly a three-dimensional system present. For example, a paint man confronted with a diffusely reflecting specimen, uniform in spectral reflectance at 20 per cent throughout the spectrum, would say without hesitation that it corresponds to a gray (Munsell value 5/) quite different from white; but if he were confronted with a transmitting specimen, uniform in spectral transmittance at 20 per cent, he would be confused and would hesitate to say that its color is different from that of a specimen (water white) that absorbs almost no light. This situation relates to the paint man's concept of the colors of transparent liquids whereby two spectrally different coloring materials are regarded as producing two different colors even though they are metamers and look exactly alike viewed by some one kind of illumination. Let us imagine a series of paint vehicles exhibiting no metamerism at all but differing in concentration of coloring material alone. Such a series of specimens will be characterized by a series of spectral-transmittance curves, each derivable from each other by Beer's law, and no one crossing any other one. The paint man will consider that the specimens in such a series have the same color in different amounts.

In the case of actual paint vehicles, however, the series of curves will not be exactly regular, because occasionally there will be curves that cross each other. All will rise with increasing wavelength, but some will have steeper slopes than others. Nevertheless, there is a close correlation between the chromaticities of the two kinds of paint vehicles; as the concentration of either kind is increased, luminous transmittance declines, and the chromaticity goes off first toward yellow, then toward red. The "amount of color" can be found from a measurement of the chromaticity aspect, as is done in the Union Colorimeter or with the Gardner standards, and alternatively the same result can be obtained from a measurement of the luminous aspect, such as in the photoelectric transmittance method proposed a few years ago for petroleum products. The correlation between these two methods is good because of the fact that there is an approach to a nonmetameric condition; but since the approach is not complete, the correlation is not perfect. This was evidenced by the correlation curve shown by Mr. Hancock.

The reason why the paint-vehicle man finds it hard to think about how to grade a sample whose transmittance is nearly constant at 20 per cent through the spectrum is that he never gets a transmittance as low as this in a nonturbid sample without having at the same time the characteristic yellow or orange chromaticity. A specimen absorbing light nonselectively with respect to wavelength is quite outside his experience and competence. Since the chromaticity of the specimen is like that of a water-white specimen, he hesitates to say that the color is different from water white. Nevertheless, turbidity itself will introduce changes of this sort; that is, it is easily possible to get very close chromaticity matches between turbid and nonturbid oils and paint vehicles. The chief visual difference would be that the turbid oil would look darker when viewed by transmitted light.

The paint-vehicle expert understands this. When he is asked to judge the color of oil—that is, how much short-wave energy is absorbed by it—he can make a reasonably valid estimate of what it would look like if the turbidity were removed. He sees that the oil is turbid, so he does not ascribe the darkness to a coloring material but to a light-scattering material.

This gets back to Mr. Scofield's comment that observers can do a very good job in estimating. If a one-dimensional series of standards, like the Gardner standards, is being used, and there are some greenish, some reddish, some clear, and some turbid specimens that cannot be matched up with any standard, nor seem to be exactly intermediate between any of them, nevertheless the observers can do a surprisingly good job in arriving at the same estimates.

One of the reasons making this possible is that the conditions of comparison are purposely or accidentally—I do not know which—chosen in such a way that chromaticity variations are emphasized, and differences in luminous transmittance are de-emphasized.

In the Union Colorimeter, for example, the fields to be compared are not side by side; they are separated. There is one circle for the specimen, another circle for the standard, and a dark space in between.

This hardly injures the ability of the observer to detect chromaticity difference between the two fields, but it very strongly suppresses his ability to tell

whether the one is lighter or darker. When the specimen is compared with a row of test tubes containing the Gardner standards, there is again this suppression of the ability to detect luminous-transmittance differences, though a close chromaticity judgment can still be made.

Therefore, one of the reasons the paint man is guided by a single one-dimensional series of standards, when he really needs perhaps three dimensions, is that he has taken out of consideration the luminous aspect of the color. This is what Mr. Scofield referred to when he said he hardly considers the color of transparent liquids as a three-dimensional problem at all.

In the first place, there is good correlation between luminous transmittance and chromaticity of nonturbid paint vehicles; and, secondly, the adopted conditions of observation conceal the luminous-transmittance differences that are present.

There are two advantages that can be derived from a series of papers covering such a wide scope as these. One is appreciation of the diverse uses of color measurement. It is surprising to note, for example, the large number of uses to which glass is put, in which it is necessary to compute CIE coordinates. Attention is called to the control of Corning Daylite glass and railroad-signal glasses. There is an ASTM color specification on the black glass or neutral-gray glass that is used in television tubes. There are problems in architectural glassware, in ophthalmic lenses and welding glasses, in Coca-Cola bottles and camera lenses, and finally, in photoelectric tristimulus filters. Here, in the glass industry alone, are many different uses of color measurement which interweave with other industries. The other papers were similarly rich in new applications of color measurement.

Another advantage to be gained from a symposium like this is to notice any similarities in the problems that face the various industries, and to see the more or less successful attempts to solve these problems. Many of the authors mention this also, that here is a method that may possibly be of assistance to someone in another industry.

In order to take full advantage of the information that can be gained from such a series of papers, it is necessary to make some analysis of the type of problem, as I have tried to do here. This enables workers in the various fields to recognize that they cannot hope to solve by spectrophotometry at a single wavelength (as is possible in the color of beer), problems of greater complexity, and that in such problems there is more need for psychophysical methods.

The analysis I have given you, on the basis of the degree of light scattering and metamerism, was the one that occurred to me as I listened to these speakers.

This is a matter for each one of us to think about and to try to clarify. I believe that then only will full value be gained in transferring from one industry to another the solutions to problems that have already been solved.

Report on IEC Jubilee Meeting

Brought to final stages of approval at the 50th Anniversay meeting of the International Electrotechnical Commission in Philadelphia September 1 through 16, were 43 International Recommendations—more world electrical standards than the IEC had produced in its entire 50-year history.

The meeting was attended by more than 800 delegates from 21 nations.

At the Jubilee Banquet, attended by 625 persons, A. C. Monteith, president of AIEE, welcomed the gathering. Walker Cisler, Detroit Edison Co., was toastmaster, and Don Mitchell, Sylvania Electric Products, delivered the main address, "Standardization, Foundation of International Progress." Richard C. Sogge, General Electric Co., president of the U. S. National Committee of the IEC, presided.

At the Jubilee Day luncheon, Dr. Comfort A. Adams, past-president of the AIEE and first president of the American Standards Assn., was guest of honor. He is one of the three living U. S. founding members of IEC.

Harold S. Osborne, former chief engineer, the American Telephone and Telegraph Co., president of IEC, presided at the Jubilee Day ceremonies.

Of the 43 International Recommendations acted upon six were approved in final form and sent to the printers, as follows:

1. The third edition of the Rules for Electrical Traction Motors, embodying modifications to the second edition which had been approved.
2. First edition of the Specifications for Electrical Equipment Installed on Motor Vehicles.
3. It was agreed that Part I of Chapter II of the Specifications for High Voltage Circuit-Breakers should be published as it stands and that the differences existing between the U. S National Committee on the one hand and the other National Committees on the other hand should be re-examined in a few years' time, when a complete second edition of the specification is prepared.
4. First edition of the Rules for Porcelain Insulators for Overhead Lines, after revision of the present draft by an editorial committee.
5. Electronic Tube and Valve Bases.
6. Electronic Tube and Valve Outlines.

Nine International Recommendations are to be circulated for final reconsideration by mail vote within two months by all IEC National Committees. These include:

1. Specifications for paper dielectric capacitors.
2. Color code for paper dielectric capacitors.
3. Specifications for tubular fluorescent lamps.
4. Standards sheets: medium and large prefocus lampholders.
5. Specification for ballasts.
6. Rules for glass insulators for overhead lines.
7. Supplement to Publication 67, Part I. Bases for Electronic Tubes and Valves.
8. It was agreed that draft specifications for tests on impregnated, paper-insulated, lead-covered cables (solid type) for voltages of 10 to 66 kv should be revised to include the amendments agreed upon at Philadelphia and circulated.
9. It was decided that a revised draft of international specifications for the construction of the enclosures of flameproof electrical apparatus, taking into account the technical and editorial improvements agreed on, should be circulated.

Finally, 28 International Recommendations are to be circulated for final approval by mail vote within six months by all IEC National Committees. These include:

Groups 65 and 70 of the International Electrotechnical vocabulary covering electrobiology and radiology; recommendations for classification of insulating materials; rotating machinery; specifications for steam turbines; four standards on aluminum; eight standards on radio communications; volume and surface resistivity and insulating resistance test methods; electric and magnetic magnitudes and units; audio-apparatus characteristics to be specified for application purposes; supplement to IEC specification for tungsten filament lamps having a life of 2500 hr; gages for interchangeability and safety of comps and holders, Types E27 and E40; ceramic caps, small and medium; dimensions of subminiature tubes and valves, bases, and outlines; caps for electronic tubes and valves; and others.

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MCA Issues Revised Butadiene Safety Data Sheet

A REVISED safety data sheet on butadiene, a chemical widely used in the manufacture of rubber products, is now available from the Manufacturing Chemists' Association.

Chemical Safety Data Sheet SD-55, covering the properties and essential information for the safe handling and use of butadiene, has been revised to include more up-to-date and complete information. In the interest of safe handling of this material, a number of important changes have been made in the sections relating to personal protective equipment and general handling procedures.

Copies may be obtained from the Manufacturing Chemists' Assn., 1625 Eye St., N. W., Washington 6, D. C.

Carey Retires from ASCE, Succeeded by W. H. Wisely

WILLIAM N. CAREY, Executive Secretary of the American Society of Civil Engineers, oldest national organization of engineers in the country, will retire May 1, 1955. Colonel Carey, former Chief Engineer of the Federal Works Agency and former City Engineer of St. Paul and distinguished in many fields of civil engineering, will become Secretary Emeritus. He will be succeeded by William H. Wisely, of Champaign, Ill., at present Executive Secretary of the Federation of Sewage and Industrial Wastes Associations and editor of its publication, *Sewage and Industrial Wastes*. Mr. Wisely will come to New York January 1 as Associate Secretary.

Calendar of Other Societies' Events

"Long" and "short" calendars will appear in alternate BULLETINS. The "short" calendar notes meetings in the few immediate weeks ahead—the "long" calendar for months ahead.

NATIONAL READY MIXED CONCRETE ASSOCIATION—January 9–13, Silver Anniversary Convention, Miami, Fla.

SOCIETY OF AUTOMOTIVE ENGINEERS, INC.—January 10–14, Annual Meeting, Sheraton-Cadillac Hotel, Detroit, Mich.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS—January 17, 1955, Annual Meeting, New York, N. Y.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—January 17–19, Hotel Statler, Washington, D. C.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS—January 24–27, 61st Annual Meeting, Commercial Museum and Bellevue-Stratford, Philadelphia, Pa.

NATIONAL CONCRETE MASONRY ASSOCIATION—January 24–27, Convention and Exposition, Cleveland Auditorium, Cleveland, Ohio.

INSTITUTE OF THE AERONAUTICAL SCIENCES—January 24–28, 23rd Annual Meeting, Hotel Astor, New York, N. Y.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—January 31–February 4, Winter Meeting, Hotel Statler, New York, N. Y.

American Society for Testing Materials—January 31–February 4, Committee Week, Netherland-Plaza Hotel, Cincinnati, Ohio.

NATIONAL CRUSHED STONE ASSOCIATION—February 7–9, Annual Convention, Netherland-Plaza Hotel, Cincinnati, Ohio.

SOCIETY OF THE PLASTICS INDUSTRY, INC.—February 8–10, Annual SPI Reinforced Plastics Div. Conf., Hotel Statler, Los Angeles, Calif.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS—February 13–17, Annual Meeting, Conrad Hilton Hotel, Chicago, Ill.

AMERICAN CONCRETE INSTITUTE—February 21–24, Annual Meeting, Hotel Schroeder, Milwaukee, Wis.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)—February 21–24, Commodore Hotel, New York, N. Y.

SOCIETY OF PLASTICS OF CANADA, INC.—February 22–23, Annual SPI Canadian Conference, Hotel London, London, Ont., Canada.

AMERICAN CHEMICAL SOCIETY AND SPECTROSCOPY SOCIETY OF PITTSBURGH—February 28–March 4, William Penn Hotel, Pittsburgh, Pa.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—March 1–3, Hotel Statler, Los Angeles, Calif.

SOCIETY OF AUTOMOTIVE ENGINEERS, INC.—March 1–3, Sheraton-Cadillac Hotel, Detroit, Mich.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS—March 7–11, 11th Annual Conference Exhibition, Palmer House, Chicago, Ill.

SOCIETY OF AUTOMOTIVE ENGINEERS, INC.—March 14–16, Meeting and Forum, Netherland-Plaza Hotel, Cincinnati, Ohio.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS—March 20–23, Kentucky Hotel, Louisville, Ky.

AMERICAN SOCIETY FOR METALS—March 28–April 1, 9th Western Metal Congress & Exposition, Pan-Pacific Auditorium, Los Angeles, Calif.

AMERICAN CHEMICAL SOCIETY—March 29–April 7, National Meeting, Cincinnati, Ohio.

SOCIETY OF THE PLASTICS INDUSTRY, INC.—April 13–15, SPI Pacific Coast Section Conference, Palm Springs, Calif.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—April 18–21, Spring Meeting, Baltimore, Md.

PERSONALS...

News items concerning the activities of our members will be welcomed for inclusion in this column.

NOTE—*These "Personals" are arranged in order of alphabetical sequence of the names. Frequently two or more members may be referred to in the same note, in which case the first one named is used as a key letter. It is believed that this arrangement will facilitate reference to the news about members.*

At the annual convention of the American Society of Civil Engineers in New York City in October, **George S. Richardson,** Consulting Engineer, Pittsburgh, Pa., was installed as a Director. **Shortridge Hardesty,** Partner, Hardesty & Hanover, New York City, was elected to honorary membership. **Jerome M. Raphael,** Associate Professor of Civil Engineering, University of California, Berkeley, was given an award for an outstanding technical paper.

At the 35th Annual Meeting of the American Welding Society in Chicago in November, **Joseph H. Humberstone,** President, Air Reduction Sales Co., Inc., New York City, was elected President. **J. J. Chyle,** Director of Welding Research, A. O. Smith Corp., Milwaukee, Wis., become 1st Vice-President. **G. O. Hoglund,** Alcoa Process Development Laboratories, New Kensington, Pa., and **J. L. Wilson,** Consulting Naval Architect and Engineer, Westfield, N. J., were elected Directors-at-large. Among the District Directors elected were **J. B. Davis** (Southwest District), Director of Tulsa Testing Laboratory, Tulsa, Okla., and **J. R. Stitt** (Detroit District), Research and Welding Engineer, R. C. Mahon Co., Detroit, Mich. **H. O. Hill,** Assistant Chief Engineer, Fabricated Steel Construction, Bethlehem Steel Co., Bethlehem, Pa., was elected an honorary member. **William L. Warner,** Engineering Research Adviser, Watertown Arsenal, Watertown, Mass., presented the AWS Adams Lecture, his subject "The Toughness of Weldability."

Among those taking prominent part in activities at the meeting of the Division of Rubber Chemistry of the American Chemical Society in New York City in September were a number of members of ASTM Committee D-11 on Rubber and Rubber-Like Materials. **Harry L. Fisher,** University of Southern California, and 1954 President of ACS, as well as active officer and member of the Rubber Division, was recognized at the 25-Year-Club Luncheon. **Ed J. Kvet,** Baldwin Rubber Co., was selected a chairman for the 25-Year-Club luncheon meeting to be held at the next Rubber Division meeting in May, 1955, in Detroit, Mich. Messrs. **J. M. Ball,** Midwest Rubber Reclaiming Co., and **A. E. Juve,** B. F. Goodrich Co., were elected Chairman and Vice-Chairman, respectively, of the Rubber Division for 1954–1955. The Charles Goodyear Medal Award was presented to **G. Stafford Whitby,** Director of Rubber Research, University of Akron. His Medal Award address was entitled "Reflections on Rubber Research."

Among the ASTM officers who were introduced recently at a large luncheon meeting of the Philadelphia Rotary Club were President **N. L. Mochel,** Past-President **H. L. Maxwell,** and Director **A. O. Schaefer.** The Society's Executive Secretary served as chairman of this meeting. Among other features was a short address on Pennsylvania Week given by M. W. Clement, Past-President of the Pennsylvania Railroad Co., who came up through the engineering branches of the company following his graduation from Trinity College. He was well acquainted with Charles B. Dudley, first President of ASTM, at Altoona, Pa.

E. W. Bauman, Managing Director, National Slag Assn., Washington, D. C., is President of the Engineers Club of Washington, D. C. Mr. Bauman has been active for many years in ASTM technical work, also in the Washington District Council.

Carl A. Bluedorn, President and General Manager, Zeidler Concrete Products Machinery Co., Waterloo, Iowa, has been elected treasurer of the Iowa Engineering Society.

John E. Brock, formerly Director of Research, Midwest Piping Co., Inc., St. Louis, Mo., is now on the faculty of the U. S. Naval Postgraduate School, Monterey, Calif., as Professor of Mechanical Engineering.

Humbert Rodriguez Causing, until recently Civil Engineer, Princeton University, Princeton, N. J., is now associated with Winston, Inc., Cartagena, Colombaa, as Chief of Soils.

Charles A. Coffey has been appointed Technical Director, Nubian Div., Glidden Co., Chicago, Ill.

Fred C. T. Daniels recently retired as Vice-President of Research and Development, Mackintosh-Hemphill Co., Pittsburgh, Pa. He will continue to serve the company in an advisory capacity, but hopes now to find more time for his favorite fishing and cruising on Barnegat Bay.

A. B. Drastrup has been elected President of A. M. Byers Co., Pittsburgh, Pa. Joining the company in 1931 as plant auditor, and serving also as special assistant to the vice-president in charge of operations during the war years, Mr. Drastrup had become manager of steel sales in 1946, assistant to the president in 1951, and executive vice-president in February, 1954.

C. Levon Eksergian, Executive Engineer and Assistant to the Executive Vice-President, The Budd Co., Philadelphia, Pa., was honored in October by The Franklin Institute by presentation of a George R. Henderson Medal, in recognition of the invention of the Disk Brake. Mr. Eksergian's brake invention applies to both self-propelled and high-speed passenger cars in railroad service.

H. B. Emerson recently retired as Manager, Service Dept., Lehigh Portland Cement Co., Chicago, Ill. Active in the cement field for many years, he had served on ASTM Committee C-15 on Manufactured Masonry Units. Mr. Emerson resides at 2204 Noyes St., Evanston, Ill.

J. C. Engibous, formerly Soil Biochemist, Monsanto Chemical Co., St. Louis Mo., is now Research Agronomist, International Minerals and Chemical Corp., Skokie, Ill.

Frederick E. Fowler is now associated with Howard, Needles, Tammen & Bergendoff, West Springfield, Mass.

John G. Frantzreb, formerly Chief Metallurgist, J. D. Adams Manufacturing Co., Indianapolis, Ind., is now Metallurgical Engineer, Caterpillar Tractor Co., East Peoria, Ill.

Paul V. Garin has been named Engineer of Research and Mechanical Standards, Southern Pacific Co., San Francisco, Calif. He was formerly Engineer of Tests. Mr. Garin has been active for many years in both technical and administrative phases of ASTM work. He is currently serving a term on the Board of Directors, and is a Past Officer of the Northern California District where he continues to serve on the Council.

Robert L. Hahn, formerly Chief Engineer, E. R. Haynes, General Contractor, Spokane, Wash., now is engaged in private practice as consulting engineer in the same city.

Edgar E. Hardy, until recently Research Supervisor, Phosphate Div., Monsanto Chemical Co., Anniston, Ala., is now Research Director, Mobay Chemical Co., in the same city.

C. E. Holdredge recently retired from the United States Steel Export Co., New York City.

Henry G. Holtz has accepted a position as Metallurgical Engineer, Materials and Processes Laboratory, General Electric Co., Schenectady, N. Y. He had been Chief Metallurgist, Taylor Forge & Pipe Works, Chicago, Ill.

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PROFESSIONAL CARDS

(*Continued from page 79*)

Fred Hubbard, Director of Research, National Slag Assn., Washington, D. C., represented the Slag Industry of the U. S. at an International Conference on Utilization of Blast-Furnace Slag in Brussels, Belgium, in October, presenting a paper entitled, "Production and Utilization of Iron Blast-Furnace Slag in the United States of America." A recognized authority in this field, Mr. Hubbard is well known in ASTM Committees C-9 on Concrete and Concrete Aggregates, and D-4 on Road and Paving Materials, currently serving as Vice-Chairman of both these groups. After the Brussels Conference, Mr. Hubbard toured Switzerland, France, Holland, Italy, and England, inspecting slag plants en route.

Sam E. Hyde, Jr., formerly Service Engineer, Cumberland Portland Cement Co., Chattanooga, Tenn., is now associated with Southern States Portland Cement Co., Albany, Ga., in a similar capacity.

Frank Ireland has been named Director of Research and Laboratories, Brown & Bigelow, St. Paul, Minn.

Robert M. Kennedy, formerly in the Procurement Dept., U. S. Marine Corps, Depot of Supplies, Philadelphia, is now Assistant Chief, Quality Assurance Office, Quartermaster Corps Inspection Service Command, U. S. Department of the Army, in the same city.

E. E. Laughlin has been named Chief Chemist, Illinois Industrial Rubber Co., Ladd, Ill., and its associated organization, The Toledo Industrial Rubber Co., Toledo, Ohio. He formerly served with Pennsylvania Rubber Co., Pharis Tire & Rubber Co., and The General Tire & Rubber Co., and was also technical adviser to a rubber company in Buenos Aires, Argentina.

Samuel R. Lloyd, until recently with H. L. Yoh., Philadelphia, Pa., is now with The Budd Co., Red Lion Plant, Aircraft Inspection Dept., in the same city.

Robert C. Madden, formerly with Columbia-Geneva Steel, Division of U. S. Steel Corp., Provo, Utah, is now Chief Metallurgist, Algoma Steel Corp., Sault Ste. Marie, Ont., Canada.

Gerald H. Mains, formerly Laboratory Director of National Vulcanized Fibre Co.'s Phenolite Division, has been named director of the company's new $200,000 Research and Development Laboratory at Yorklyn, Del., which will be the scene of research activities for all divisions of the company. Assisting Mr. Mains will be **Alfred J. Green,** as manager of the new project. **Frederick L. Stiegler** will be in charge of the Paper and Fibre Section, while **Joseph C. Pesce** will head up the Phenolite Section.

Samuel G. MacNeill is now associated with the Charles C. Kawin Co., Chicago Ill., as Metallurgical Engineer. He formerly was connected with the Cannon-Muskegon Corp.

Eugene C. Medcalf has been named manager of the newly established Coal Tar Chemicals Section of American Cyanamid Co.'s General Purchasing Department. The new organization, operating at the Bound Brook, N. J., plant, will combine the responsibilities previously assigned to the Coal Tar Chemicals Dept. and company purchasing units.

D. F. Murphy, until recently with Champion Forge Co., Cleveland, Ohio, is now associated with Ajax Steel and Forge Co., Detroit, Mich.

A. L. Penhale, formerly Sales Manager is now President & Managing Director, Asbestos Corp. Ltd., Thetford Mines, Que., Canada.

L. B. Parsons, Director of Research and Development, Lever Brothers Co., Edgewater, N. J., has been elected a Vice-President of the Company.

Walter H. Prine is now head of the Electroplating-Chemical-Catalyst Section of the Nickel Sales Department of International Nickel Co., Inc., New York City.

L. J. Rohl has been appointed to the recently created position of Chief Metallurgical Engineer of the U. S. Steel Corp. He will coordinate the Metallurgical activities of all the divisions. **R. W. Simons** has been named Chief Metallurgical Engineer, Operations-Steel, succeeding Mr. Rohl. Mr. Rohl joined U. S. Steel at South Works, Chicago, in 1917. Mr. Simon has been associated with the company since 1927 when he joined as a metallurgical assistant at the Homestead Works.

Raymond L. Sanford, Assistant Chief, Electricity and Electronics Div., National Bureau of Standards, and Chief of the Magnetic Measurements Section, has retired from the Bureau after more than 44 years of service. Mr. Sanford is known throughout the world for his work in magnetic measurements. He has contributed inventions, researches, and publications on the application of magnetic measurements to the nondestructive testing of many types of ferrous materials ranging from elevator cables to prison bars. In 1951 he received the Department of Commerce Meritorious Service Award for his work in the magnetic measurement field. In ASTM Mr. Sanford has long been affiliated with Committee A-6 on Magnetic Principles, serving as Secretary from 1920 until 1948, and as Chairman from 1948 to 1954.

Charles E. Schaffner has been promoted to the position of Assistant Administrative Dean, Polytechnic Institute of Brooklyn. Dean Schaffner has been director of the evening session since 1951, in addition to being in charge of surveying and the highway materials testing laboratory. He is also a consultant to industry, conducting research and tests on specific construction developments and problems.

Karl Schwartzwalder has been named Director of Research, AC Spark Plug Division of General Motors Corp., Flint, Mich. He had been Chief Ceramic Engineer since 1944.

T. Smith Taylor, formerly Director of Research, U. S. Testing Co., Hoboken, N. J., has been appointed Director of Testing, Rand Development Corp., Cleveland, Ohio. A longtime, active ASTM member, Dr. Taylor was the Society's 1937 Edgar Marburg Lecturer. He has participated intensively in the work of Committee D-9 on Electrical Insulating Materials, serving terms as chairman and secretary, and continuing active in many of the subgroups. In recognition of his outstanding and constructive interest he was honored with an ASTM Award of Merit in 1950.

George Robert Thompson has been appointed to the executive staff of Giffels & Vallet, Inc., L. Rossetti, Associated Engineers and Architects, Detroit, Mich. He recently retired as Detroit's City Engineer, a position he had held during the past 17 years. He also had served the State of Michigan as budget director and consulting engineer.

Kent R. Van Horn, Director of Research, Aluminum Company of America, New Kensington, Pa., presented the Campbell Memorial Lecture of the American Society for Metals at the Metal Show in November in Chicago. The lecture, sponsored by ASM as a memorial to Edward DeMille Campbell, is presented annually by a leader in the field of metallurgy. Dr. Van Horn's subject was "Factors Affecting Directional Properties in Aluminum Wrought Products."

Mary Elizabeth Warga, Professor of Physics in charge of the Spectroscopy Laboratory at the University of Pittsburgh, was one of the 1954 group of ten "Distinguished Daughters of Pennsylvania" receiving gold medals for achievement from Governor Fine in Harrisburg on October 5. This year's ceremonies brought to 70 the total of women who have received this coveted honor in the State since it was instituted in 1949. Dr. Warga has brought distinction to Pennsylvania "through her work in the field of spectroscopy and through her organizational activities in connection with the Optical Society of America and the Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy." In ASTM Dr. Warga has been a valued contributor to the work of Committee E-2 on Emission Spectroscopy since 1936 serving as secretary 1944 to 1950; also is active in the Pittsburgh District Council.

Fred A. Warr has retired as Technical Supervisor, The American Brass Co., Ansonia, Conn.

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W. Andrew Wesley has been appointed head of the Research Laboratory, International Nickel Co., Inc., Bayonne, N. J. Dr. Wesley became a member of the staff at Bayonne in 1926 as a research chemist.

Griffith Williams, Jr. is now Superintendent of Industrial Engineering for the Bridgeport Brass Co., Adrian, Mich. Previously he had been located at the Indianapolis plant as Process Engineer.

F. P. Zimmerli has been appointed Director of Engineering and Research for the Associated Spring Corp. He will assume his new duties January 1, 1955, and relinquish his position of Chief Engineer of the Barnes-Gibson-Raymond Division of Associated Spring, Plymouth, Mich., at that time. A member and officer of numerous engineering and technical groups, Mr. Zimmerli has been very active for many years in both administrative and technical ASTM work. He was chairman of the Detroit District, 1948–1950, and also served a term on the Board of Directors of the Society. He is a member of Committees A-1 on Steel and E-9 on Fatigue, and for some time served on Committee B-4 on Metals for Electrical Heating, Electrical Resistance, and Electronic Applications. Through the years Mr. Zimmerli has written many technical papers concerning specifications of spring materials, shot peening, effect of heat on spring steels, as well as the engineering mechanics and metallurgy used by the spring industry.

Bureau of Standards Notes

Harry C. Allen, Jr., has been appointed to the staff of the Bureau to conduct research in molecular spectroscopy and the interpretation of vibrational-rotational spectra. He has been assigned to the Radiometry Section. Prior to becoming a staff member Dr. Allen was an Assistant Professor of Physics at Michigan State College. Previously he held an Atomic Energy Commission Postdoctoral Fellowship for study at Harvard University. He has written a number of papers in the field of spectroscopy.

Harold Lyons has been appointed Assistant Chief for Research of the Radio Standards Division of the National Bureau of Standards Boulder, Colo., Laboratories. He will direct research phases of the Division's standards program, including development of improved transfer standards, methods of measurement, instruments, and instrumentation techniques. He will continue his work on atomic clocks and microwave frequency standards, in which he has been active since 1946 and for which he received the Arthur S. Flemming Award for outstanding Government service in 1948. Dr. Lyons joined the NBS staff in 1941 to head several units conducting research on radar countermeasures and radar windsounding equipment. In 1946 he was appointed Chief of the Microwave Standards Laboratory.

Russell B. Scott has been appointed Chief of the NBS-AEC Cryogenic Engineering Laboratory, a division of the Bureau. This laboratory is a major part of the new NBS Boulder Laboratories in Colorado. Mr. Scott has directed the Bureau's work in this field since 1952. The increased application of the liquefied low-temperature gases in national defense and industry has necessitated larger, more convenient, and less hazardous equipment for producing and handling these liquids. As a result, many new and highly complex engineering problems have arisen in the low-temperature field, where much remains to be learned about the behavior of engineering materials. Cryogenic Engineering Division is therefore investigating the engineering properties of matter at low temperatures and is carrying out a program of research and development directed chiefly toward the improvement of materials, structural elements, and equipment for low-temperature use. The laboratory is also equipped to produce liquid nitrogen, oxygen, helium, and hydrogen in the large quantities required for a program of his type. Mr. Scott joined the staff of the Low-Temperature (later the Cryogenic Physics) Section of the Bureau in 1928.

NEW MEMBERS...

The following 49 members were elected from September 28 to November 9, 1954, making the total membership 7774 . . . . Welcome to ASTM

Note—Names are arranged alphabetically—company members first, then individuals

CHICAGO DISTRICT

Knudson, Warren A., Vice-President, Engineering, Silvercote Products, Inc., 161 E. Erie St., Chicago 11, Ill.

Quayle, Melvin G., Technical Service Manager, Zonolite Co., 135 S. LaSalle St., Chicago 3, Ill.

Vaurio, Frans, Plastics and Resins Dept., The Institute of Paper Chemistry, Appleton, Wis.

CLEVELAND DISTRICT

Preformed Line Products Co., Jon R. Ruhlman, Technical Director, 5349 St. Clair Ave., Cleveland 3, Ohio.

Barrett, George N., Jr., Chief Metallurgist, Cleveland Pneumatic Tool Co., 3781 E. Seventy-seventh St., Cleveland 5, Ohio.

Groves, Karl, Materials and Process Engineer, The Lamb Electric Co., 627 Lake St., Kent, Ohio.

Tenenbaum, M. R., Sales Engineer, Machine Sales, Lester Phoenix, Inc., 2711 Church Ave., Cleveland 13, Ohio. For mail: 3315 Clayton Blvd., Shaker Heights 20, Ohio.

Yearley, B. C., Director of Applied Research, National Malleable and Steel Castings Co., 10600 Quincy, Cleveland, Ohio.

DETROIT DISTRICT

Couch, Frank L., Professional Engineer, Smith, Hinchman & Grylls, Inc., 800 Marquette Bldg., 243 W. Congress St., Detroit 26, Mich.

Phillips, Charles William, Assistant Professor of Metallurgy, Department of Chemical and Metallurgical Engineering, University of Michigan, Ann Arbor, Mich.

NEW ENGLAND DISTRICT

Eastern Refractories Co., Inc., Edward W. Booth, Insulation Engineer, 70 Pearl St., Brookline, Mass.

Bivins, Maude, Instructor of Textiles, School of Home Economics, University of Connecticut, Storrs, Conn.

Pitney, Kenneth E., Assistant Director, Industrial Div., The J. M. Ney Co., 71 Elm St., Hartford, Conn.

NEW YORK DISTRICT

Bart Manufacturing Co., James P. McNally, Metallurgist, 229 Main St., Belleville, N. J.

Honeycomb Company of America, Inc., Frank J. Quinlan, Vice-President, 3 Burroughs St., Bridgeport 8, Conn.

American Electroplaters' Society, P. P. Kovatis, Executive Secretary, 445 Broad St., Newark 2, N. J.

Duffy, Frank K., Executive Assistant, The Greif Brothers Cooperage Corp., Box 398, Lindenhurst, L. I., N. Y.

Elkow, Milton O., Resident Engineer, D. B. Steinman, Consulting Engineer, 117 Liberty St., New York, N. Y. For mail: 5 Miller Lane, Kingston, N. Y.

Feuchtbaum, Robert Bernard, Head, Materials Testing Lab., Freed Transformer Co., 1718 Weirfield St., Brooklyn Ridgewood 27, N. Y. For mail: 1906 E. Thirty-eighth St., Brooklyn 34, N. Y. [J]*

Glazer, John B., Textile Chemist, N. Erlanger, Blumgart and Co., Inc., 181 Madison Ave., New York 16, N. Y.

Maag, Heinrich, Dipl. Eng. ETH, Sia, St. Gall, Switzerland. For mail: 7300 Boulevard East, North Bergen, N. J.

O'Sullivan, James J., Technical Service, North American Cement Corp., 41 E. Forty-second St., New York 17, N. Y.

Shepard, Arthur F., Chief Development Engineer, Metallizing Engineering Co., 1101 Prospect Ave., Westbury, L. I., N. Y.

Tilden, S. G., Jr., Chief Engineer, The Permafuse Corp., 675 Main St., Westbury, L. I., N. Y.

Walker, Alan Bruce, Research and Development, Air Cruisers Co., Box 180, Belmar, N. J.

NORTHERN CALIFORNIA DISTRICT

California-Spray Chemical Corp., A. J. Tihenko, Chief Control and Development Chemist, Richmond, Calif.

OHIO VALLEY DISTRICT

Maupin, Addison, Assistant to President, The Charles Taylor Sons Co., 710 Burns St., Cincinnati, Ohio.

Messick, Harold V., Research Engineer, Fuels and Lubricants Div., Ashland Oil and Refining Co., Ashland, Ky.

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PHILADELPHIA DISTRICT

Bauman, C. Uhler, Production and Inspection Officer, Philadelphia District, Corps of Engineers, U. S. Department of the Army, 2635 Abbotsford Ave., Philadelphia 29, Pa. For mail: 131 Wyndmoor Rd., Springfield, Delaware Co., Pa.

Bolton, Alfred E., Jr., Materials Inspector, Metallurgical Engineering, Westinghouse Electric Corp., Lester Branch, Philadelphia 13, Pa. For mail: 308 Walnut Ave., Aldan, Clifton Heights, Pa.

Gronemeyer, George E., Registered Engineer, Black Rock Rd., R.D. 2, Morrisville, Pa.

Hart, William J., Technical Director, Barbizon Corp., Scranton, Pa. For mail: The Jaunty Fabric Corp., Poplar and Park Sts., Scranton, Pa.

Kemmerer, W. G., Engineer of Bridges and Buildings, Pennsylvania Railroad Co., Room 440, Thirtieth St., Station, Philadelphia 4, Pa.

Milhausen, William J., Metallurgist, Esterbrook Pen Co., Delaware Ave. and Cooper St., Camden 1, N. J.

PITTSBURGH DISTRICT

Hazlett, Frank P., Technical Representative, United States Steel Corp., Coal Chemical Sales Div., 525 William Penn Pl., Pittsburgh 30, Pa.

Magill, Fulton R., Standards Engineer, Rockwell Manufacturing Co., 400 N. Lexington Ave., Pittsburgh 8, Pa. For mail: 1401 Highland Ave., New Castle, Pa.

ST. LOUIS DISTRICT

Johnston Foil Manufacturing Co., F. B. Catanzaro, Chemist, 6106 S. Broadway, St. Louis 11, Mo.

Starks, Ralph James, Physicist, Eagle-Picher Co., Research Dept., Box 290, Joplin, Mo. For mail: 233 Jackson Ave., Joplin, Mo.

SOUTHERN CALIFORNIA DISTRICT

Fink, Wally B., Zenith Aircraft, Division of Zenith Plastics, 1584 W. 135th St., Gardena, Calif.

Witt, Russell E., Chief Engineer, Douglas Roesch, Inc., 2200 S. Figueroa St., Los Angeles 7, Calif.

SOUTHWEST DISTRICT

Benham, David, Senior Partner, Benham Engineering Co., 215 N. E. Twenty-third St., Oklahoma City 5, Okla.

Fanshier, Chester, President and General Manager, Metal Goods Manufacturing Co., 106–110 S. Park Ave., Bartlesville, Okla. For mail: Box 676, Bartlesville, Okla.

Rogers, Roy, Electroplating Foreman, Slick Airways, Inc., Alamo Field, San Antonio, Tex.

WESTERN NEW YORK–ONTARIO DISTRICT

Rondeau, H. F., Research Engineer, American Meter Co., Inc., 920 Payne Ave., Erie, Pa.

UNITED STATES AND POSSESSIONS

Carlson, Arthur C., Superintendent, Anacortes Veneer, Inc., Box 71, Anacortes, Wash.

OTHER THAN U. S. POSSESSIONS

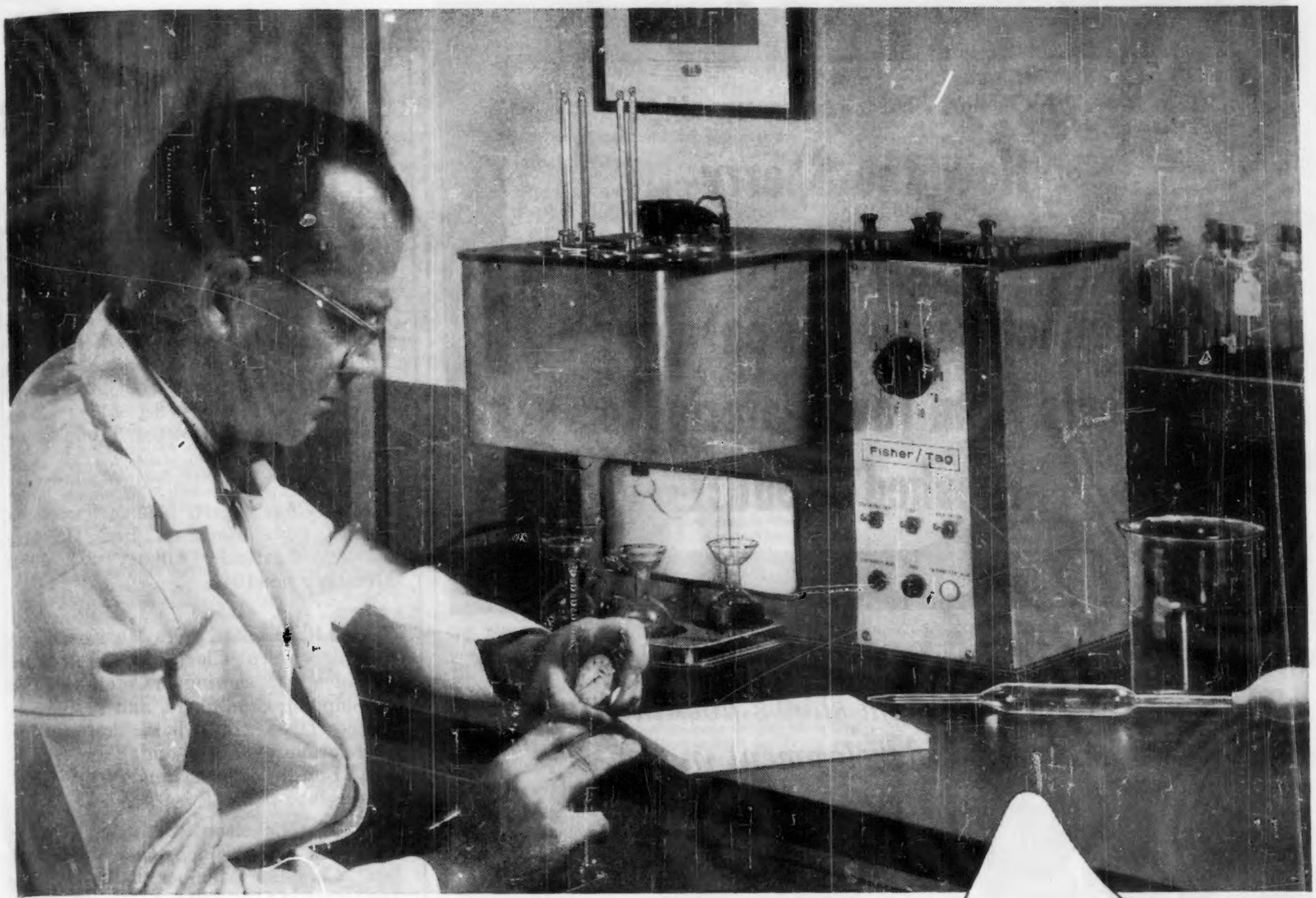
Refinaria e Exploracao de Petroleo "Uniao" S. A., C. E. Paes Barreto, Refinery Manager, Praca Ramos de Azevedo, 206, Andar, São Paulo, Brazil.

Escudero, Ricardo, Serrano Jover num 2, Madrid, Spain.

Garcia, Nieves, Manager, Concretos Monterrey, S. A., Escobedo 733, Desp. 317, Monterrey, N. L., Mexico.

Smith, J. Roland, Chief Librarian, Ministry of Supply, Division of Atomic Energy, Risley, Warrington, Lancashire, England.

* [J] denotes Junior member.



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The key to its reliability is its ability to hold oil samples within .02°F. (.01°C) at temperatures ranging between 60° and 220°F (15.5-104.4°C). Fisher achieves this with a completely new thermostated circulating bath encasing the standard Saybolt tubes.

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DEATHS...

Webster L. Benham, Owner, Benham Engineering Co., Oklahoma City, Okla. (1952). Member since 1946.

John C. Day, Secretary, Western Petroleum Refiners Assn., Tulsa, Okla. (October 5, 1954). Representative of Association membership since 1946; also representative of WPRA on Committee D-2 on Petroleum Products and Lubricants, Technical Committee E on Burner Fuel Oils and its Subcommittees I on Reference Fuels and III on Fuel Oil Specifications; and ASA Z11 Sectional Committee on Petroleum Products and Lubricants.

E. F. Mactaggart, former Director of Sondes Place Research Inst., Dorking, Surrey, England (August 27, 1954). Member since 1949.

Fred R. Mueller, Sales Manager, Cozier Container Corp., Cleveland, Ohio. Member since 1945, serving on Committee D-10 on Shipping Containers, and its Subcommittees II on Methods of Testing, V on Correlation of Tests and Test Results, and VI on Interior Packing.

C. M. Nicholson, Ceramic Engineer, American Nepheline, Ltd., Lakefield, Ont., Canada. Member of Society since 1952, and of Committee C-21 on Ceramic Whiteware and Similar Products.

Ragnar Olof Oskar Schlyter, Director, Statens Hantverksinstitut, Stockholm, Sweden (February, 1954). Member since 1947.

E. J. Tompkins, Metallurgical Engineer, Central Steel and Wire Co., Chicago, Ill. (September, 1954). Member since 1943, serving on Committee A-1 on Steel and its Subcommittee XV on Bar Steels.

Francis P. Witmer, Prospect Park, Pa., retired civil engineer (October 27, 1954). Member since 1910. A graduate of the University of Pennsylvania, class of 1893, Mr. Witmer returned to the University as Director of Civil Engineering in 1924, and remained there until 1943. From 1901 to 1913 he was a bridge designer with the American Bridge Co. He later joined the engineering staff of the Municipal Railway Co. of New York, remaining until 1919. From 1919 to 1943 he was consulting engineer with H. C. Baird Co., New York, and from 1943 to 1953 he was with the Kuljian Corp., Philadelphia. He was affiliated with a number of engineering and technical groups.

The world's largest smokestack, built with more than 18,000 tons of brick, is said to be the enormous stack of the Anaconda Copper Mining Co., at Great Falls, Montana. It is 585 ft tall with an inside diameter of 60 ft at the top.

Laboratory Supplies and Testing Equipment

Note—This information is based on literature and statements from apparatus manufacturers and laboratory supply house

Catalogs and Literature

Filter Papers—A new catalog of Whatman filter papers is now available from H. Reeve Angel & Co. Filter papers featured in this 20-page brochure include: qualitative grades and qualities, qualities washed in hydrochloric and hydrofluoric acids, hardened, folded, extraction thimbles, milk analysis strips, absorption blocks, and others.

H. Reeve Angel & Co., Inc., 52 Duane St., New York 7, N. Y.

Battelle Research—An informative 24-page brochure has been published by Battelle Memorial Institute outlining the complete coverage of Battelle's research in the field of technology. Profusely illustrated, this brochure summarizes the Battelle plan of operation, indicates personnel, facilities, and equipment available.

Battelle Memorial Institute, 505 King Ave., Columbus 1, Ohio.

Gas Analysis Kits—*Bulletin No. 306* describes and offers Kwik-Chek Gas Analysis Kits for on-the-job determinations of carbon dioxide or oxygen in flue gases, furnace atmospheres, and other gas mixtures. Available from Burrell Corp., the new analyzers feature simplicity of operation, speed of analyses, and ease of making accurate readings. The bulletin describes simple procedures, lists all components contained in the kits, and furnishes catalog numbers and prices. Copies free on request.

Burrell Corp., 2223 Fifth Ave., Pittsburgh 19, Pa.

Photofluorometer—A new photofluorometer, the Model 12 C, has been announced by Coleman Instruments, Inc. The Model 12 C offers a greatly increased sensitivity and improved stability which enable it to deliver accurate data both at very faint fluorescence levels and lower concentrations than those previously convenient to handle. Write for *Bulletin B-230.*

Coleman Instruments, Inc., 318 Madison St., Maywood, Ill.

Scientific Equipment—A new issue of the *Announcer* has been published by Eberbach & Son Co. The feature article deals with the National Research Council of Canada. Additional articles cover the following apparatus: incubators, gravity convection ovens, interference filters, and water demineralizers.

Eberbach & Son Co., 200 E. Liberty St., Ann Arbor, Mich.

Measuring and Testing Equipment—A general catalog covering measuring and testing instruments has been announced by the Instrument Div. of Federal Telephone and Radio Co. The catalog gives a brief technical description of a representative cross section of the instruments offered by the company. Copies available from Rudolf Feldt, Manager, Instrument Div.

Federal Telephone and Radio Co., 100 Kingsland Rd., Clifton, N. J.

Laboratory Instrumentation—A recent issue of *The Laboratory*, Vol. 24, No. 1, features a six-page report on the rise of chemotherapy. Among the new instruments announced is the amperometric titrimeter; an appliance described is the watch/guard, a company-designed stopwatch holder with a combination of new

(*Continued on page 92*)

(Continued from page 90)

features that brings new convenience to lab timing.

Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

Testing Instruments—Procedures for testing paper stocks, textiles, leather, plastics, and other sheet materials are described in "Gurley Testing Instruments," an illustrated bulletin published by W. & L. E. Gurley. Among the tests outlined are standard procedures for determining stiffness, smoothness, porosity, and softness. Write for copy of *Bulletin 1400*.

W. & L. E. Gurley, Industrial Div., Troy, N. Y.

Spectrograph with Order Sorter—An eight-page catalog, "The JAco Ebert Plane Grating Spectrograph with Order Sorter," has just been published by Jarrell-Ash Co. The catalog illustrates and describes in detail this spectrograph that is adapted to all spectra, from the simplest to the most complex. Of special interest is the section devoted to the description of the Order Sorter—a tool that provides wide wavelength coverage and good speed at high dispersion and resolution. Request copy of *Catalog EE-10-54* by writing to the company, attention Mr. Richard Ashley.

Jarrell-Ash Co., 26 Farwell St., Newtonville, Mass.

Constant-Temperature Bath with Air-Well Tubes—Labline, Inc. has developed an eight-unit constant temperature bath with air-well tubes for determining free and corrosive sulfur in petroleum products. The apparatus can be used to run tests in accordance with ASTM Method D 130. Write for *Bulletin 4090*.

Labline, Inc., 217–221 N. Des Plaines St., Chicago 6, Ill.

New Laboratory Apparatus—An issue of LANCO Apparatus News, now available from Arthur S. LaPine & Co., Vol. 6, No. 2, features Stuart and Briegleb atom models. This 12-page bulletin describes two dozen other items of laboratory equipment. Among these are apparatus for subsieve range particle size analysis, test sieve vibrator, balance with 311 g capacity, infrared water bath, and lattice rod support clamps.

Arthur S. LaPine & Co., 6001 S. Knox Ave., Chicago 29, Ill.

Polyethylene Laboratory Ware—An eight-page catalog containing a most comprehensive and descriptive listing, including 35 illustrations of Polyethylene Laboratory Ware has been announced by Palo Laboratory Supplies, Inc. Literature supplied upon request.

Palo Laboratory Supplies, Inc., 81 Reade St., New York 7, N. Y.

Amperometric Titration Cell—Precision Scientific Co. announces the publication of *Data Sheet No. 11285* on the Precision-Shell Amperometric Titration Cell. This illustrated bulletin describes the applications and advantages of the apparatus when used with a polarographic instrument for analytical investigations. Data Sheet No. 11285 will be sent on request.

Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

Scientific Apparatus and Methods—A new issue of *Scientific Apparatus and Methods*, released by E. N. Sargent and Co., features two articles, one covering "Thermistors as Better Thermometers," and the other dealing with "Precise Oscillometric Analysis of Two-Component Single Phase Liquids." A section is included listing new and reinstated items and indicating changes in specifications.

E. H. Sargent and Co., 4647 W. Foster Ave., Chicago 30, Ill.

Universal Recording Balance—A bulletin just published by The Sharples Corp. illustrates and describes the principle of operation and functioning of this precision instrument which is specifically designed for the observation and recording of small rapidly changing forces with respect to time. Copy of *Bulletin 103* from the company.

The Sharples Corp. Research Labs., 4[illegible] W. 4th St., Bridgeport, Pa.

Thomas Roto-Cell (Accessory for Bausch & Lomb "Spectronic 20" Colorimeter)—Arthur H. Thomas Co. has developed a liquid-cooled double cell carrier for use with the new B. & L. "Spectronic 20" Colorimeter to make it suitable for rapid spectrophotometric scanning at controlled temperatures. The Roto-Cell is readily interchangeable with the single-place sample holder regularly supplied

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(Continued from page 92)
with the instrument and provides for instantaneous interchange within the instrument of a 1-ml. sample with the blank or standard into the light path, thereby greatly facilitating preparation of spectral transmission or absorption curves. Descriptive *Bulletin 121* sent upon request.

Arthur H. Thomas Co., P.O. Box 779, Philadelphia 5, Pa.

Chromatography Catalog—This 24-page catalog, recently announced by Will Corp., contains the latest in equipment, apparatus, and supplies, including solvents and adsorbents, preferred by workers in the field of chromatography. Each item is completely described, pictured, and priced.

Will Corp., Rochester 3, N. Y.

Instrument Notes

Concrete Test Chamber—A new environmental chamber developed by Conrad, Inc. is capable of handling all three ASTM testing procedures, automatically, without manual adjustment. A predetermined test program can be set up on the chamber covering from one to eight cycles over a 24-hr period. These cycles include freezing the concrete in air and thawing in water; freezing and thawing in water; freezing and thawing in brine.

Conrad, Inc., 183 Jefferson Ave., Holland, Mich.

Leak Detector—A new ultra-sensitive leak detector capable of detecting one part of helium in two million parts of air, is now available from Consolidated Engineering Corp. A simplified mass spectrometer, the new instrument designated Type 24-110 is sensitive to minute traces of inert, noncontaminating helium. *Bulletin 801 C* available on request.

Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.

Mechanical Pressure Gage—W. C. Dillon & Co., Inc., are pleased to announce a new high capacity mechanical pressure gage. This new model measures compressive forces from 0 to 10,000 lb with a warranted accuracy of within 1 per cent of indicated reading and will sustain accidental overloads of up to 25 per cent without injury to calibration. The Dillon Pressure Gage is available in ten ranges, from 0 to 10 lb up to the new 0 to 10,000-lb model.

W. C. Dillon & Co., Inc., P.O. Box 3008, Van Nuys, Calif.

Direct Measuring Microscope—A new direct measuring, erect image microscope has been announced by the Edmund Scientific Corp. The direct measuring microscope is used to obtain accurate readings of dimensions, radii, angles, and holes. Linear dimensions are given both in decimal inches and millimeters. It can be used for measuring rubber, soft plastics, and other flexible materials, assembled mechanisms, liquid spots or deposits, surface irregularities, mesh sizes, and grain sizes.

Edmund Scientific Corp., Barrington, N. J.

Vacuum-Distillation Column—A company-made, vacuum-jacketed distilling column has been announced by Glass Engineering Labs. The apparatus provides for standardized operations to be conducted under vacuum. The unit was developed to coordinate with a standardization program relating to the use of ASTM-type distillation for the characterization of lubricating oils and reduced crudes.

Glass Engineering Labs., 511 O'Neill Ave., Belmont, Calif.

Universal Hardness Tester—Availability of a new hardness tester, permitting the performance of Rockwell, Brinnell, as well as Vickers hardness tests with one single unit, has been announced by William J. Hacker & Co., Inc. This machine accommodates specimens up to 19 in. in height, permits accurate measurement of penetrations to 0.0008 in., and is equipped with single-lever operation for load application and release.

William J. Hacker & Co., Inc., 82 Beaver St., New York 5, N. Y.

Stress Analyzer—A portable stress analyzer using the X-ray diffraction method is available for field and plant operations. Known as the "Androscope," it measures the magnitude and sense of residual stresses in metals, plastics, and other materials. Manufactured and sold by Holger Andreasen, Inc., it transfers practical nondestructive residual stress measuring from the laboratory to the field and plant.

Holger Andreasen, Inc., 703 Market St., San Francisco 3, Calif.

Microspectrophotometer—A new double-beam microspectrophotometer that can be used to analyze solutions in volumes ranging from as small as 0.015 ml up to several milliliters has been announced by the Jarrell-Ash Co. A design feature is the use of interchangeable micro and macro cuvettes of the appropriate volume and path length. The new instrument utilizes a single meter that is calibrated to indicate the ratio of the optical densities of concentrations.

Jarrell-Ash Co., 26 Farwell St., Newtonville, Mass.

Gum Test Apparatus—A new Gum Test Apparatus for tests conducted in accordance with ASTM Method D 381 is now available from Labline, Inc. The unit is designed to run five gum tests simultaneously in motor, aviation, and jet fuels with air jets or superheated steam jets. This Gum Test Apparatus is said to be the only one available with built-in steam superheater.

Labline, Inc., 217 N. Des Plaines St., Chicago 6, Ill.

Combined Hot Plate-Magnetic Stirrer—The LANCO combined hot plate-magnetic stirrer, available from Arthur S. La Pine & Co., makes it possible to heat liquids while stirring magnetically. Rheostat control of the motor enables "dialing in" the most effective speed for stirring a particular liquid. An input controller obtains infinitely variable heating from 0 to 400 watts.

Arthur S. La Pine & Co., 6001 S. Knox Ave., Chicago 29, Ill.

Panel-Mounted pH Indicator—A new Panel-Mounted Indicator for continuous measurement of pH or redox in manufacturing processes is offered by Leeds & Northrup Co. The company states that the instrument is moisture-proof and gives accurate readings after less than a one minute warm-up, without the use of desiccants. It is also reported that the Indicator is unaffected by line voltage surges, electrical pick-up, and zero drift.

Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

Rapid Analysis of Sulfur in Petroleum with High Frequency Combustion Unit—Fast combustion of heavy and light hydrocarbons is now possible with the LI-500P "H-F" Combustion Unit offered by Lindberg Engineering Co. The induction furnace itself, prior to being modified for combustion of petroleum samples, was used extensively for sulfur and carbon determination in the ferrous industry. All samples covered by ASTM Bomb or Lamp Method can be completely combusted.

Lindberg Engineering Co., 2450 W. Hubbard St., Chicago 12, Ill.

Automatic Multi-Element Indexing X-Ray Spectrograph—A new Autrometer, an automatic multi-element indexing X-ray spectrograph that gives percentages of as many as twelve elements in a specimen in a range of over 71 elements in the periodic table, has been announced by the Research and Control Instruments Div., North American Philips Co., Inc. The machine is radiation proofed and provides accurate and rapid analysis of products in any critical stage of manufacture and indicates the need for addition or removal of elements to guarantee uniformity of mixes, batches, or degree of purity of components.

Research & Control Instruments Div., North American Philips Co., Inc., Mount Vernon, N. Y.

Paddle Narrow-Mouthed Containers—A new mixing aid by Palo Laboratory Supplies, Inc., has just been announced. The paddle, named Flexistir, is designed to give thorough agitation to the contents of any container of not less than ⅝ in. diameter. Flexistir comes in two standard sizes or it can be ordered to exact specifications.

Palo Laboratory Supplies, Inc., 81 Reade St., New York 7, N. Y.

"Color-Glance" Brinell Hardness Tester Makes Possible Automatic Operation—Three colored lights, which signal the relative Brinell hardness of the test piece, make all the decisions of acceptability or rejection on a new *"color-glance"* Brinell Hardness Testing Machine recently announced by Steel City Testing Machines, Inc. The three signal lights are set up so that yellow indicates "too hard," green designates "within range," and red shows "too soft." Limits are easily adjustable to suit the requirements of each job. During the test cycle, one of these lights flashes on, indicating the hardness category of the part under test.

Steel City Testing Machines, Inc., 8817 Lyndon Ave., Detroit 38, Mich.

Instrument Company News

Consolidated Engineering Corp., Pasadena, Calif.—Phillip A. Wilner has been promoted to the position of manager of the Detroit District Office of CEC Instru-

ments, Inc., a sales and service subsidiary, according to an announcement by Joseph F. Davidson, director of sales. Joining CEC Instruments, Inc. as a sales engineer, Wilner later became resident field engineer in charge of Detroit district operations.

Arthur S. La Pine & Co., Chicago, Ill.—According to a recent company announcement, Ben Sherill will represent the company in Minnesota and Iowa. Mr. Sherill's address is 5017 Fifteenth Ave. South, Minneapolis 17, Minn.

E. H. Sargent & Co., Chicago, Ill.—Jack Trommater, who has been active in the sales work of the company for a number of years, has been appointed sales manager of the Chicago division by Robert J. Reinarts, general sales manager.

Wheeler Co., Inc., Topeka, Kan.—A new Kansas corporation has been chartered to engage in the manufacture and sale of the Wheeler Testing Vibrator. The name of this corporation is Wheeler Co., Inc. with the main office at 2408 Harrison St., Topeka, Kan.

Laboratory News

Ledoux & Co., Teaneck, N. J.—This company has adopted a bromination technique for the determination of oxygen in various materials. The costs are less than one half those incurred in making similar analyses by the vacuum-fusion method, while the results are comparable in accuracy.

Foster D. Snell, Inc., New York, N. Y.—The appointment of J. G. Detwiler to the staff of Foster D. Snell, Inc. as a Petroleum Consultant has been announced by John B. Calkin, Assistant to the President. Mr. Detwiler will be available for consulting work on the chemical problems of the petroleum industry. Mr. Detwiler has been identified with research and development work in the cracking of petroleum, refining technique, anti-knock fuels, lubrication, and in petrochemicals.

Foster D. Snell, Inc., New York, N. Y.—Dr. Egon L. Sudy has been appointed to the staff of Foster D. Snell, Inc., consulting chemists and engineers. With offices at Jose M. Montero 2931, Montevideo, Uruguay, and in Buenos Aires, Santiago, Chile, and in São Paulo, Dr. Sudy will be the technical representative for Foster D. Snell, Inc., in Argentina, Brazil, Chile, and Uruguay.

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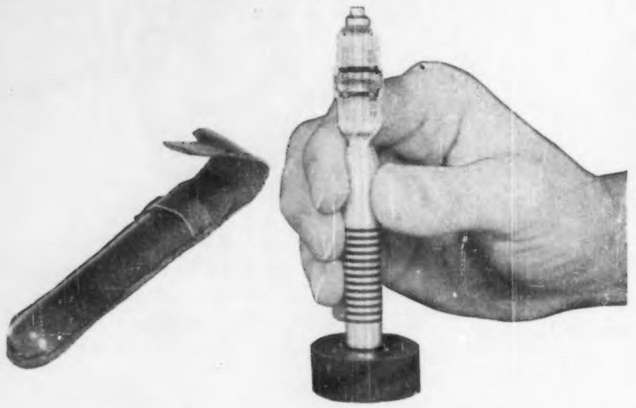

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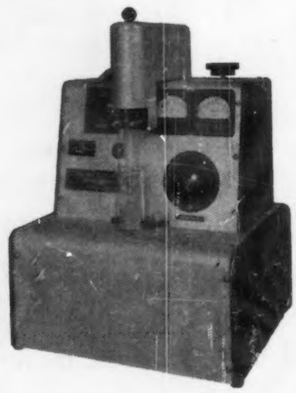

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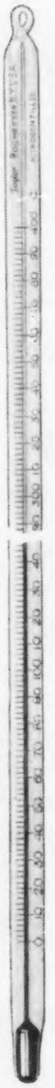

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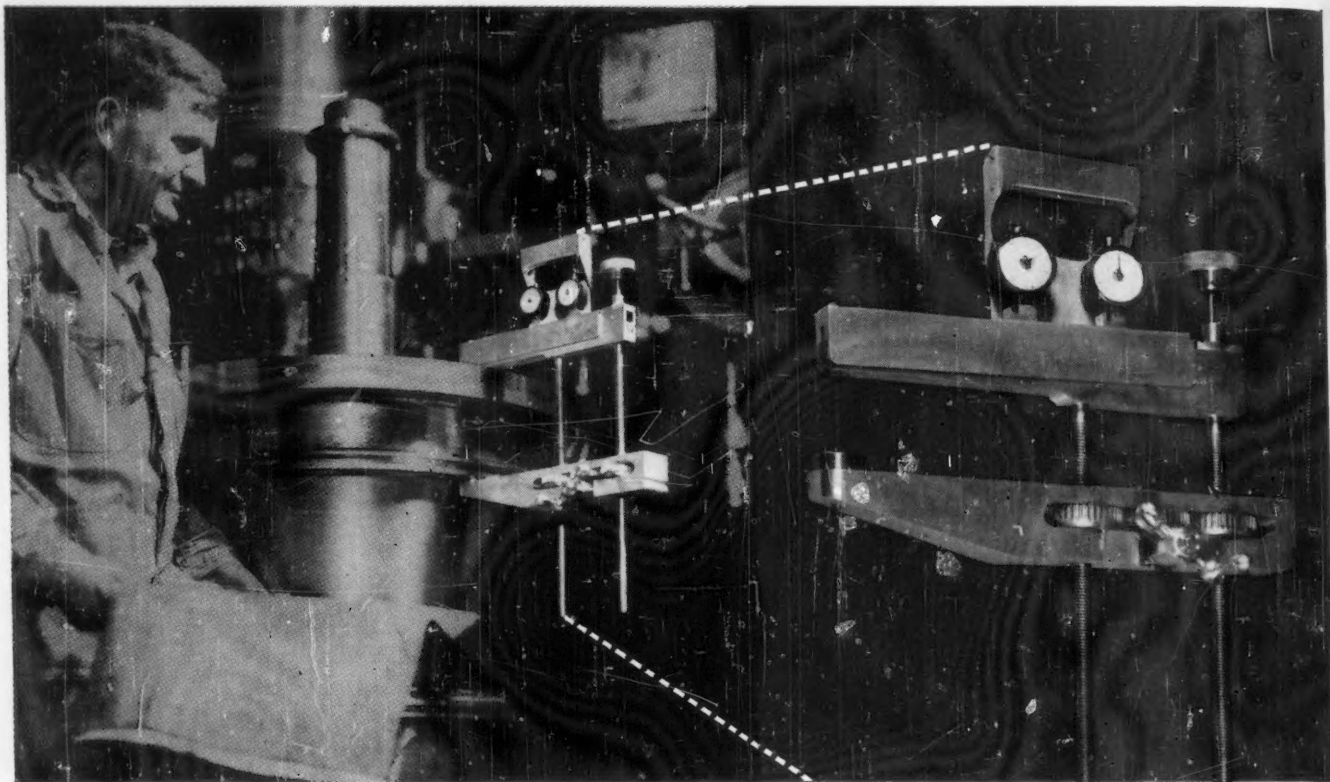

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DECEMBER 1954

Number 202

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ASTM Bulletin is indexed regularly by Engineering Index, Inc.

ASTM Bulletin, December 1954. Published eight times a year, January, February, April, May, July, September, October, and December, by the American Society for Testing Materials. Publication Office—20th and Northampton Sts., Easton, Pa. Editorial and advertising offices at the headquarters of the Society, 1916 Race St., Philadelphia 3, Pa. Subscriptions, United States and possessions, one year, $2.75, two years, $4.75, three years, $6.50, Canada, one year, $3.25, two years, $5.75, three years, $8.00. Other countries, one year, $3.75, two years, $6.75, three years, $9.50. Single Copies—50 cents. Number 202. Entered as second class matter, April 8, 1940, at the post office at Easton, Pa., under the act of March 3, 1879.

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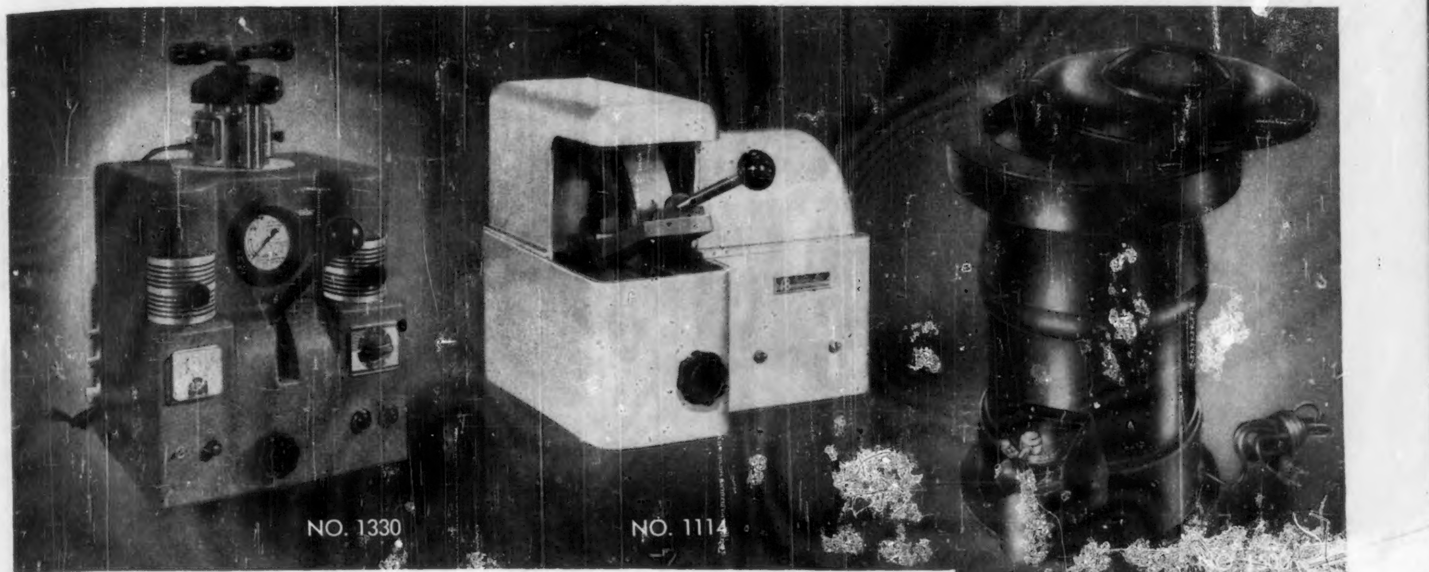
Kimble Graduated Cylinders Nos. 20025 (2000 ml.; 500 ml.).



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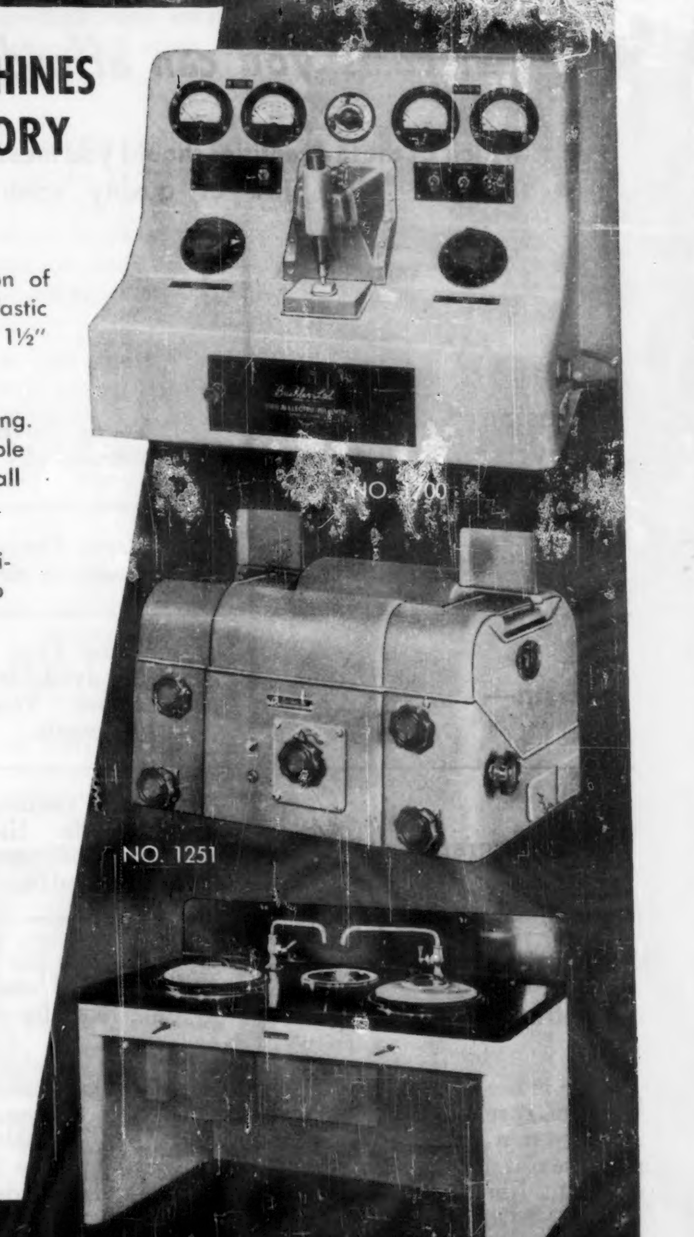

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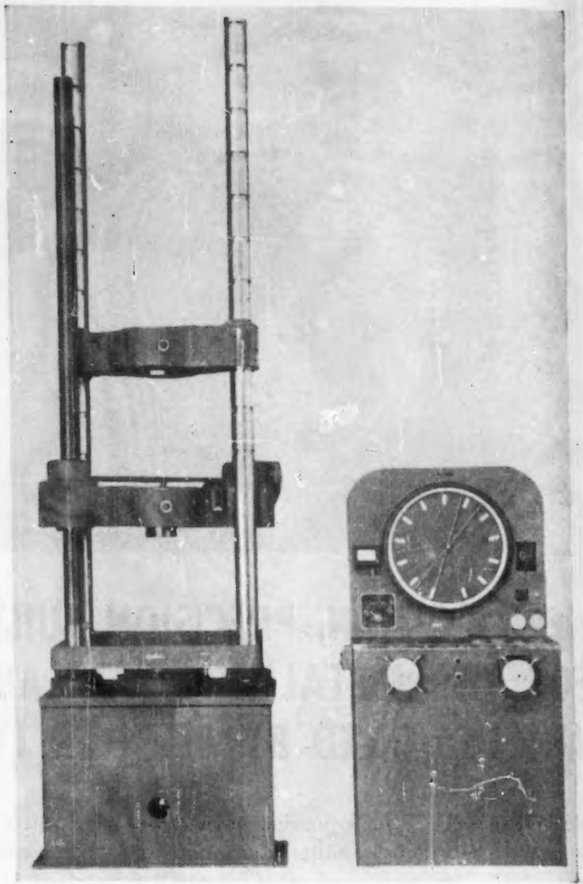

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